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THE INSECTS OF PUERTO RICO

George N. Wolcott

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THE INSECTS OF PUERTO RICO

By GEORGE N. WOLCOTT

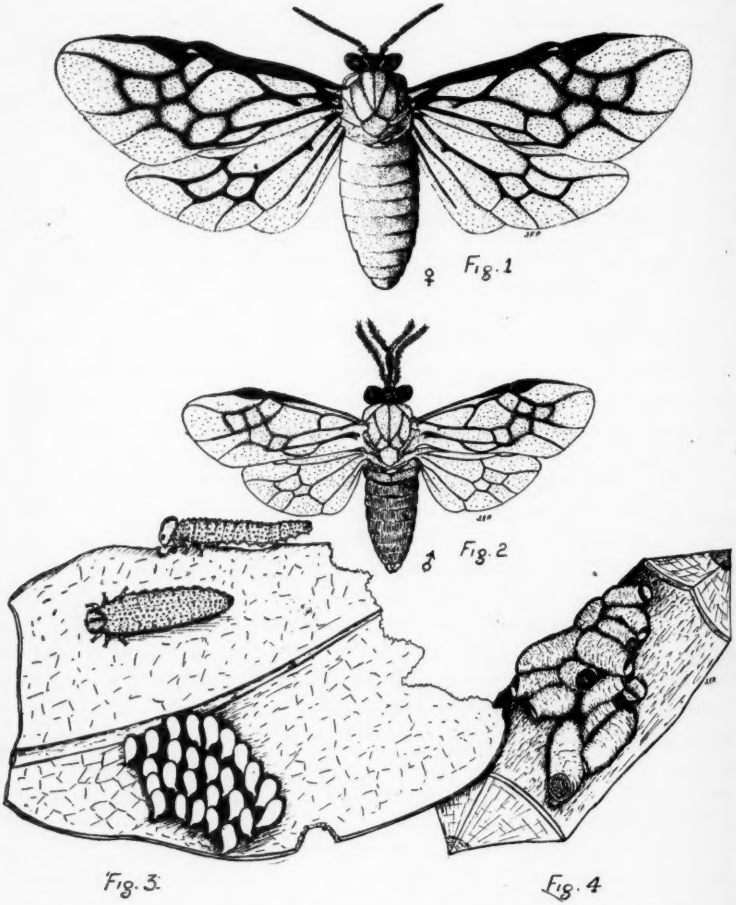
HYMENOPTERA

TENTHREDINOIDEA: Tenthredinidae: Sawflies

The single sawfly of Puerto Rico was originally described under the name *Schizocera* **krugii** by Mr. E. T. Cresson (Trans. Amer. Ent. Soc., **8**: 54. Philadelphia, 1880), presumably from material sent him by the German Consul at Mayagüez: Herr D. Leopoldo Krug. This was a year previous to the description as *S. zaddachi* by Dr. Hermann Dewitz in "Hymenopteren von Portorico" (Berliner Ent. Zeit., **25** (2): 197–208. Berlin, 1881) of this and other Hymenoptera sent him by Dr. Gundlach. *Xylosericocera* is only a MS generic name under which it has since been placed, but **Sericocera** appears to be the correct genus in which it should be included according to the latest opinion of the systematists. Its somewhat rusty greenish-yellow, caterpillar-like larvae feed primarily on the leaves of the seagrape, *Coccoloba uvifera*, often more or less completely defoliating long stretches of these bushes along the beach, and leaving windrows of excrement on the sand underneath the naked branches and leaf midribs of its host. Mr. R. H. Van Zwaluwenburg, who first intensively studied the habits of this insect in the environs of Mayagüez, as given in his "Report of the Entomologist" (*in* Rpt. P. R. Agr. Station, 1917, p. 28. Washington, D. C., February 5, 1918), records it also feeding on "icaco" or coco plum (*Chrysobalanus icaco*), but no one has found it since on this host. It does, however, feed on other species of *Coccoloba*, Dr. Luis F. Martorell (Caribbean Forester, **2** (3): 141–4, pl. 1. New Orleans, April 1941) having noted it on "moralón" (*C. grandifolia*) between Lares and Bayaney, on *C. pyrifolia* at Guavate, Cayey, and on "cucubano" (*C. laurifolia*) in the Maricao Forest, thousands of feet above what one is inclined to think is its normal habitat: on the beach just above sea-level.

The slender oval eggs are stuck on the leaf by one end, in a circular patch, arranged almost as equally distant from each other as the pins in a bowling alley. The thin, tough, parchment-like cocoons are attached to the trunk or branches of the seagrape, often in such numbers and so closely cemented to each other that they can be pulled off in a continuous strip.

They are not very durable, however, and rarely survive as shelter for other insects long after the emergence of the adults. The adults have shining



The Seagrape Sawfly, *Sericocera krugii* (Cresson); 1, adult female, about six times natural size, 2, adult male, 3, larvae and eggs on seagrape leaf, 4, cocoons. (Drawn by José F. Pietri.)

black head and eyes, and bright chestnut red thorax, which fades to a dull yellow-brown in museum specimens. The simple antennae of the plump females contrast with the two-branched, plumose antennae of the more ac-

tive males, which may hover in clouds in the lee of a clump of seagrape on which the females are resting.

Everywhere around the Island where seagrape grows these insects have been noted in abundance, but they are not reported from Cuba or Hispaniola, and possibly a reason why seagrape grows so luxuriantly on Mona Island is the absence of this pest. We have no records from Vieques and Culebra, but what is presumably the same species has been noted on seagrape at Paramaribo, Dutch Guiana. So far as we know, **Sericocera krugii** has no natural enemies, certainly no specific parasites, and Dr. Wetmore found it eaten by no bird. Yet after defoliating a section of the seagrapes of a beach, the insect disappears completely for months, or a year or longer, altho it may at the same time be abundant somewhere else. Most recorded outbreaks occur in the autumn or winter on seagrape, and those on other hosts in the mountains in the spring and summer, possibly indicating a mass migration depending on temperature, but one heavy infestation at Ponce was in July. Defoliation of seagrape bushes is normally so complete, and may occur so often, as to indicate this insect as unquestionably a contributing factor in preventing seagrape from often becoming a tree in Puerto Rico.

ICHNEUMONOIDEA: Braconidae

Alysia analis Cresson, as identified by Mr. A. B. Gahan, is a slender little (6.0 mm. long) black wasp, with the thorax and basal half or third of the abdomen bright chestnut, found in all parts of the Island: equally abundant in the cane fields of the coast and in the coffee groves of the mountains. Of its host relationships, nothing is known. The predaceous black and red bug *Zelus longipes* L. was observed in the mountains back of Yauco, at Indiera, feeding on one of these wasps, but we have no record of its serving as food for any bird, lizard or toad.

Alysia ridibunda Say, as identified by Mr. R. A. Cushman, is so rare in Puerto Rico that only a single specimen has been collected.

From the fruitfly traps at Mayagüez, several specimens of a new species of **Goniarcha,** as determined by Mr. C. F. W. Muesebeck, have been taken.

The fruitflies, for which these traps were set, were early found to be parasitized by what Mr. H. L. Viereck in his "Descriptions of Ten New Genera and Twenty-five New Species of Ichneumon Flies" (Proc. U. S. National Museum, **44** (1968): 555–568. Washington, D. C., April 18, 1913) named **Opius (Utetes) anastrephae,** from material reared by Dr. C. W. Hooker, of the Mayagüez Station, who gave the host as *Anastrepha fraterculus* Wiedemann (now known as *A. suspensa* Loew) maggots from the fruits of "jobo" *Spondias lutea* (now *S. mombin*). These very small yellow wasps have been repeatedly reared from this host in the western end of the Island

and in the mountains as far east as Cidra, but they are not very abundant, and presumably exert only a slight degree of control on their specific host.

Opius insularis Ashmead, as determined by Mr. A. B. Gahan, is a similar little yellow wasp which Mr. E. G. Smyth reared from Agromyzid pupae in *Hyptis pectinata*, one parasite from each pupa. Those reared by Mr. A. S. Mills from the pupae of *Agromyza jucunda* in the leaves of wild morning glory at Vega Alta were determined by Mr. C. F. W. Muesebeck as being a new species of **Opius**. From pupae of the Olethreutid moth, *Crocidosema plebeiana* Zeller, the larvae of which feed in the seed heads of "escoba" (*Sida cordifolia*) which he collected at Dorado, wasps emerged which Mr. Muesebeck identified as of this genus.

From a single pupa of the Pyralid "higüerillo" leaf-webber, *Pilocrocis inguinalis* (Guenée), collected by Dr. Luis F. Martorell at Cayey, seventeen small wasps emerged which Mr. Muesebeck identified as a new species of **Microgaster**.

Wasps of the genus *Mirax* are characterized by having 14-segmented antennae and wings of which, according to Mr. Muesebeck as stated in "A Revision of the North American Ichneumon-Flies belonging to the Subfamilies Neoneurinae and Microgasterinae" (Proc. U. S. National Museum, **61** (2436) Art. 15, 1–76, pl. 1. Washington, D. C., 1922), the "first intercubitus is long, attaining the broad triangular stigma, from the middle of which arises the radius, not angled, obsolete at extreme base." Until quite recently, no species of *Mirax* was known to occur in the West Indies, and "studies have been difficult because of the paucity of available specimens. Those species of which the habits are known are parasites of lepidopterous leaf-miners or bast-miners."

The coffee leaf-miner, *Leucoptera coffeella* (Guérin-Méneville), most exhaustively studied in Puerto Rico by Mr. Francisco Sein, was found by him to be parasitized by numerous small wasps of which none occurred in sufficient numbers to exert an appreciable effect on its abundance. In the coffee groves of the island of Guadeloupe, French West Indies, he found, however, that from 65 to 80 per cent of the leaf-miner larvae were parasitized by what Mr. C. F. W. Muesebeck named **insularis:** "A New West Indian Species of **Mirax** Haliday parasitic on the Coffee Leaf-Miner (Hymenoptera: Braconidae)" (Proc. Ent. Soc. Washington, **39** (6): 139–141, fig. 1. Washington, D. C., June 18, 1935). *Mirax insularis* is also present in St. Lucia and Dominica of the Lesser Antilles, but being most abundant in Guadeloupe, it was from that Island that shipments of the parasite were made to Puerto Rico in 1937 and 1938, for release in coffee groves at Guaynabo, Quebradillas and Lares. Recoveries of this little yellowish-brown wasp several generations later were made at Quebradillas and Lares, and

extensive collections were made for a number of years thereafter. In September 1940, a peak of parasitization of this wasp of 2.9 percent of parasitized leaf-miner larvae was noted at Lares, but for most of the time when observations were made, only a fraction of one percent of the caterpillar larvae were attacked. Following the extreme dry weather of the first half of the year 1947, however, Mr. Sein found that this imported parasite had attacked 13% of the leaf-miners at Lares in the coffee grove where it had been originally released, this being slightly more than the parasitism by all the native wasp parasites observed at this time. It had been presumed that rainfall and humidity in Guadeloupe coffee groves was approximately that of similar environments in Puerto Rico, but apparently only under extreme conditions of drought (for coffee groves) does this imported parasite become abundant. Its future course can hardly be predicted, but it would appear from all observations to date that the single effective parasite of the coffee leaf-miner in Guadeloupe, when introduced into Puerto Rico in competition with numerous others, becomes only one among many during normal weather conditions, and a quite insignificant factor in control.

In 1921, Mr. C. F. W. Muesebeck's "Revision of the North American Species of Ichneumon-Flies belonging to the Genus *Apanteles*" (Proc. U. S. National Museum, **58** (2349): 483–576, Washington, D. C.) was published, in which all the species of these slender little black wasps known from Puerto Rico up to that time were recorded and keyed, and one new species from Puerto Rico was described. The *Apanteles* wasps are exclusively parasitic on caterpillars. If the caterpillar is small, only one or a few wasps develop from it. But if the caterpillar is very large, great numbers of wasp maggots may find sufficient nourishment inside its capacious body for complete development, and, emerging from approximately evenly spaced points on its crumpling skin when fully-grown, may be so numerous that the silk of their closely-packed cocoons coalesces to form a shining white silken cylinder, out of which the shriveled skin of the parasitized caterpillar often falls before the adult wasps begin to emerge.

Apanteles dignus was described from California by Mr. C. F. W. Muesebeck (Proc. Ent. Soc. Washington, **40** (7): 203, Washington, D. C., October 27, 1938), from *Gnorimoschema lycopersicella* (Busck), the pepper flower-bud moth. In the original description, Mr. Muesebeck states: "In addition to the type series, I have before me three females and two males, unquestionably the same species, reared from *Gnorimoschema gudmannella* (Walsingham), at St. Croix, Virgin Islands, in March 1922", which considerably antedates the first record from this host for Puerto Rico.

Apanteles xanthopus, parasitic on the caterpillar of *Diatraea saccharalis* (F.) at São Paulo, was introduced into Puerto Rico in "Seven shipments of

sugarcane borer parasites received from Brasil" by Dr. K. A. Bartlett (Mayagüez Station Report for 1946, p. 31).

The clothes-moth parasite, **Apanteles carpatus** (Say), has been collected in an apartment house in San Juan, and in the cabin of a boat in the harbor, but has not been reared from the local equivalent, *Tineola walsinghami* Busck, the plaster bagworm or flattened case-bearer that infests the walls of houses, feeding on the remains of dead insects and spiders, and on woolen blankets and clothes if opportunity offers. Even when fully-grown, these caterpillars are quite small, furnishing nourishment for the development of but a single parasitic wasp.

At the other extreme are the species of *Apanteles* which parasitize large sphinx caterpillars, so numerous at times that they may form a considerable item in the food of the lizards *Anolis pulchellus*, *A. krugii* and *A. cristatellus*. In Cuba, six hyperparasites of **Apanteles americanus** (Lepeletier) are recorded. *Elasmus maculatus* Howard and an undetermined species of *Horismenus* have been reared from it in Puerto Rico when parasitizing the sphinx of yuca, and *Stiboscopus thoracicus* Ashmead as a parasite of its cocoons on the tobacco hornworm. The latter wasp is presumed to be normally an inhabitant of coffee groves and the virgin forests of the mountains, but we have no other record of its host relationships, and it may be an important factor in the control of the parasite of the tobacco hornworm, which is rarely noted attacked by *Apanteles americanus*. The sphinx caterpillars of papaya and yuca, on the contrary, are more often found attacked than free from parasitism. The first record of this wasp in Puerto Rico is of rearing by Mr. August Busck from a sphinx on "pawpaw". Presumably this was *Erinnyis alope* (Drury), which normally feeds on papaya foliage, as it has repeatedly since been found parasitized by *Apanteles americanus*, as is also the similar *Erinnyis ello* (L.), which feeds on yuca.

Dr. Gundlach, in his account of the yuca sphinx, most unfortunately was apparently recording a mis-identification of the parasite. "La oruga se cria en *Jatropha Manihot*. Muchas orugas mueren, porque un himenóptero pequeño pone centenares de huevos en una sola oruga. Las larvas de estos himenópteros, que son *Microgaster flaviventris* Cresson, salen del cuerpo, cada una forma un capullito blanco uno al lado del otro y estos todos juntos parecen una mota de algodón, pegada en el peciolo u hoja de la planta." From such an authority on Cuban fauna, this name was accepted without question by Mr. Patricio Cardín in his account of the "Insectos y Enfermedades de la Yuca en Cuba" (Bol. No. 20, pp. 28, pl. 8, Estación Experimental Agronómica, Santiago de las Vegas, July 1911), and Mr. R. H. Van Zwaluwenburg has the same specific name, *Protapanteles flaviventris* Cresson (5023), for the parasites he reared from this host in Puerto Rico. No host record is given by Cresson for the type material

from Cuba, and Mr. Muesebeck is of the opinion "that the true *flaviventris* will prove a synonym of *americanus* (Lep.)."

The sphinx caterpillar *Protambulix strigilis* (L.), feeding on "guanábana", *Annona muricata*, and the tobacco hornworm, *Phlegethontius sexta jamaicensis* Butler, are host to **Apanteles congregatus** (Say).

Mr. H. L. Viereck, receiving material which Dr. C. W. Hooker, at the Mayagüez Experiment Station, had reared from an undetermined sphinx, named the wasp after the place of its origin, **Apanteles mayaguezensis** (1913-563). Wasps identified as this species by Mr. A. B. Gahan have since been reared from a sphinx feeding on the leaves of *Cissus sicyoides*, the wild grape which is known to be the food plant for both *Pholus labruscae* (L.) and *Pholus vitis vitis* (L.).

A small cotton caterpillar, *Alabama argillacea* (Hübner), collected at Hatillo, was host for just two maggots of **Apanteles aletiae** Riley, as determined by Mr. A. B. Gahan. This is a continental species, which, as indicated by its specific name, should attack only cotton caterpillars. In Cuba, however, where cotton is not a commercial crop, it has been reared from another similar looper caterpillar, *Gonodonta mutrix* Cramer, which feeds on *Annona glabra*.

Another looper caterpillar of the genus *Phytometra* was fully-grown when numerous maggots began emerging from it, the adults of which were identified by Mr. Muesebeck as **Apanteles guayanensis** Cameron.

Apanteles militaris Walsh has been reared in Puerto Rico from a caterpillar of *Leucania latiuscula* (Herrich-Schäffer), which is a cutworm of sugar cane leaves and grasses, and not a looper.

This cutworm is also host for **Apanteles marginiventris** (Cresson), of which, according to Mr. A. B. Gahan, *Apanteles grenadensis* Ashmead is a synonym, both described from West Indian material. Its more normal host is the southern grassworm, *Laphygma frugiperda* (Abbot & Smith), of which large numbers of the small caterpillars are often attacked, so that one sometimes finds numerous individual cocoons of this wasp scattered about on cane leaves eaten by the grassworm.

Apanteles disputabilis Ashmead, as determined by Mr. Muesebeck, was noted in great abundance by Dr. Luis F. Martorell on the flowers of "malva de caballo" (*Malachra alceifolia*), beside a cane field near Central Rufina, Guayanilla. This West Indian species, found also in the southern United States, was described from St. Vincent of the Lesser Antilles. At Haina, Dominican Republic, it was reared from larva of *Panoquina nyctelia* (Latreille), a leaf-rolling skipper caterpillar which feeds on the leaves of sugar-cane.

The type of **Apanteles prenidis** Muesebeck (1920-558) was reared by Mr. Thos. H. Jones from the same species of skipper caterpillar, which

at that time was called *Prenes ares* Felder, in a cane field of Hda. Monserrate, Luquillo. As few as five parasites may develop in a single small larva, but in a more fully-grown caterpillar the mass of white cocoons may almost fill the silken shelter in the rolled-over cane leaf which this skipper heavily reinforces when about to pupate. The other common skipper caterpillar of sugar-cane, *Panoquina nero belli* Watson, is also host for *Apanteles prenidis*.

The common skipper caterpillar on beans, *Urbanus proteus* (L.), is host for **Apanteles leucostigma** (Ashmead), described from St. Vincent and Grenada of the Lesser Antilles, but since reared from this host in all the Greater Antilles. In Cuba, this wasp has as hyperparasites *Horismenus eudami* Girault and *Elasmus maculatus* Howard.

Mr. C. F. W. Muesebeck has identified as "near *nigriceps* Ashmead" an *Apanteles* collected in a citrus grove at Pueblo Viejo. Undetermined species of *Apanteles* have been reared from *Lamprosema indicata* (F.) at Isabela, from *Pseudohemiceras krugii* Möschler at Salinas, from *Phostria martyralis* (Lederer) at Guayama, and from *Crocidosema plebeiana* Zeller at Dorado, but as all but the last of these are Pyralid hosts, the numerous records may indicate but a single species of *Apanteles*. From the Pyralid *Desmia ufeus* (Cramer) has been reared **Apanteles ruficollis** (Cameron) as determined by Mr. Muesebeck, and from the Bougainvillea leaf-tyer, *Sylepta gordialis* (Guenée), a new species very similar to *ruficollis*.

Iphiaulax voraginis (Cresson), which Dr. Gundlach reports collecting at Quebradillas, and Dewitz lists as a *Bracon*, was originally described from Cuban material as being "rufous; head, antennae and legs, black; wings fuscuous, abdomen broad, with deep excavation on each side of the second segment and a smaller one on each side of the third segment; ovipositor longer than the abdomen", and Mr. Cresson also mentions a large hyaline spot on the fuscous wings, and gives the length of the female as two and one-half lines. This agrees fairly well with specimens collected by Dr. Luis F. Martorell in considerable abundance on the tops of bushes on the plateau of Mona Island, identified by Miss G. A. Sandhouse as a species of *Iphiaulax*, and may represent what Dr. Gundlach found in Puerto Rico. The males are much smaller, and Martorell found them much more numerous than the very conspicuous females, with their broad, shining, bright chestnut abdomens.

Dr. Gundlach collected at Mayagüez and Dewitz lists another of Cresson's Cuban species of *Bracon*, subsequently found at the same locality by Mr. R. H. Van Zwaluwenburg (50) and identified for him as **Monogonogaster ventralis** (Cresson). This is larger, four and three-quarters lines long, "readily distinguished from the other species by the abdomen only

being rufous", and has most recently been collected in a citrus grove at Trujillo Alto.

Bracon guanicana Wolcott ("IP" 1923-67), is mostly shining yellowish brown, 6.0 mm. long, described from specimens collected in a screen trap in the garden at Hda. Santa Rita, Guánica, by Mr. E. G. Smyth, and since found on swamp vegetation at Boquerón.

Among the "Imported Parasites of Pink Bollworm at Presidio, Tex. 1932-36" handled by Messrs. L. W. Noble and W. T. Hunt (Jour. Ec. Ent., 30 (6): 242–44. Menasha, December 1937) were over three thousand *Exeristes roborator* F. from southern Europe and Egypt, fourteen thousand *Chelonus blackburni* Cameron from Hawaii, and forty thousand *Microbracon kirkpatricki* Wilk. from east central Africa, which were sent to Puerto Rico for release in areas infested by the pink bollworm. None of these has since been recovered, but so many little wasps were subsequently noted on the window-sills of the cotton ginnery and warehouse at Isabela that several people who had watched with interest the release of the parasites were sure that millions of them were being destroyed by being trapped in the ginnery. Specimens collected in January 1940, submitted to Mr. C. F. W. Muesebeck, were identified as **Microbracon hebetor** Say. This is a wasp previously reported once from Puerto Rico: resting on pigeon peas at Ponce. It is a common continental species, "length 2–3 mm., black with yellowish markings, variable in color and size, (which) apparently exclusively attacks the Lepidoptera in stored grain, dried fruits, etc.", according to Prof. E. O. Essig (1926–783). No pink bollworm moths were noted dead or alive on the windows of the Isabela ginnery at the time when these wasps were so abundant, but numerous stored grain moths were present. Mr. L. Courtney Fife, in his study of the cotton insects of Puerto Rico (Bulletin No. 39, Mayagüez Experiment Station, pp. 14, ref. 45. Washington, D. C., March 1939) noted that "two species of pyralids were found attacking stored cottonseed, namely *Ephestia cautella* and *Corcyra cephalonica*. The larvae of this species (the former) were rather heavily parasitized by *Microbracon hebetor*." Two other less abundant species of *Microbracon* have been definitely identified from Puerto Rico, besides several others not placed as to species.

Microbracon cushmani Muesebeck, as identified by Mr. Muesebeck, was reared by Dr. Luis F. Martorell from caterpillars of the roble leaf-roller, *Eulepte concordalis* Hübner, at Naguabo, Maunabo and Mona Island. From the shrunken skins of dead caterpillars numerous creamy maggots emerged, resting on the leaf before beginning to spin their fine silken cocoons and darkening for pupation, as noted by Dr. Martorell (Caribbean Forester, **2** (1): 19. New Orleans, October 1940).

Microbracon thurberiphagae Muesebeck has been reared from the caterpillars of the lima bean pod-borer, *Maruca testulalis* (Geyer), at Cidra and at Vega Baja, but obviously is too rare to be a serious factor in the economic control of this pest.

No specific name was assigned to those *Microbracon* wasps reared by Mr. Thos. H. Jones from the sugar-cane skipper caterpillar, *Panoquina nyctelia* (Latreille), at Luquillo and at Río Piedras. Numerous fine yellowish silken cocoons of the parasite were crowded into the shelter which this caterpillar makes by folding over a leaf, and from them emerged light yellow adult wasps. No subsequent rearing in Puerto Rico has been made from this host, but from a similar leaf-roller on rice at Haina, Dominican Republic, similar adults were considered by Mr. Muesebeck to be "possibly *femoratus.*" From the leaf-miner, *Acrocercops dives* (Walsingham), in the leaves of *Inga vera*, collected by Mr. Francisco Seín at Lares, he reared a wasp of this genus, and Mr. A. S. Mills reared from the escoba seed-head borer, *Crocidosema plebeiana* Zeller, another undetermined species of *Microbracon*. The one reared from fruitfly maggots, *Anastrepha mombinpraeoptans* Seín, as reported by Dr. K. A. Bartlett, is most certainly a new species.

In addition to the *Chelonus blackburni* Cameron introduced into Puerto Rico to combat the pink bollworm, a comparable introduction against the sugar-cane moth borer, *Diatraea saccharalis* (F.), was made (Rpt. P. R. Agr. Expt. Station at Mayagüez, 1938, p. 97. Washington, D. C., November 1938) of the wasp parasite *Chelonus annulipes* Wesm. "This braconid is a small wasp which was imported into the United States from Italy (and reared at the Toledo, Ohio laboratory) as a parasite of the European corn borer, *Pyrausta nubilalis* (Hübner). Under laboratory conditions (at Mayagüez), it was possible to obtain oviposition by *Chelonus* in *Diatraea* eggs and to rear the parasites successfully through to the adult stage. Of the total of 65,800 *Chelonus* adults shipped from Toledo, 43,459 arrived alive. Liberations were made throughout the cane-growing areas under various environmental conditions, a total of 43,249 adults being liberated in colonies of approximately 1,000 each". And, as in the case of *Chelonus blackburni*, no subsequent field recovery of *Chelonus annulipes* has been reported.

Endemic species of *Chelonus* do occur in Puerto Rico, however, **Chelonus meridonalis** Ashmead having been identified by Mr. Muesebeck from material intercepted on *Pluchea purpurascens* at Pt. Cangrejos by Mr. A. S. Mills, and also by him, **Chelonus texanus** Cresson on weeds at Loíza. Mr. Francisco Seín has reared an unidentified species of **Chelonus** from the pepper flower-bud moth, *Gnorimoschema gudmannella* (Walsingham).

Chelonus insularis Cresson, originally described from Cuba, but early found in Puerto Rico by Dr. Gundlach, and listed by him and Dewitz, and

subsequently by Van Zwaluwenburg, is considerably more abundant, and potentially of much greater economic importance. In the first year that Mr. D. L. Van Dine spent in Puerto Rico he reared it from a partly grown corn earworm, *Heliothis armigera* (Hübner) collected at Caguas, September 3, 1911 and accompanied by the young British Entomologist, Mr. G. E. Bodkin, en route to Demerara after having taken graduate work in the United States as a Carnegie scholar, on January 5, 1913, oviposition was observed at Guánica in the hairy egg-clusters of *Laphygma frugiperda* (Abbot & Smith). In the humid, swampy cane fields of British Guiana, Mr. Bodkin was promptly to repeat this observation, and rear adults. Because Mr. Thos. H. Jones at that time had in preparation a paper on the southern grassworm in Puerto Rico, the unique method of oviposition and development of the parasite was not reported by Mr. Van Dine.

"The female of *Chelonus insularis* Cresson, after removing a portion of the hairs from the egg-cluster, lays her eggs in the eggs of the moth. Caterpillars from these eggs issue normally, but they contain the maggots of the wasp which kill them before they are more than half grown. The small caterpillars enter the soil as if about to pupate, but soon die, and cocoons of the parasite will be found within the shriveled remains of the host caterpillar". Thus wrote Mr. Thos. H. Jones in describing its parasitism of one of "The Caterpillars which eat the leaves of Sugar-Cane in Porto Rico" (Jour. Agr. Dept. P. R., **6** (1): 38–50, fig. 9. San Juan, October 1922). Surprisingly enough, the parasite appears to be not particularly specialized as to host, for recently Dr. Luis F. Martorell reared adults, definitely identified as being this species by Mr. C. F. W. Muesebeck, from the caterpillars of the guano leaf-roller, *Pantographa limata* Grote & Robinson. The adult wasp, to paraphrase Mr. Cresson's original description, is two and one-half lines long, opaque black, finely and densely rugose or shagreened, except for obscurely testaceous legs and "a more or less distinct pale spot on each side of the abdomen near its base". The abdomen appears unsegmented, showing no ovipositor at apex, which is broadly rounded. The wings are hyaline, the apical half faintly dusky. Adults are often noted in fields of young corn or cane, and are indeed of sufficient abundance at times as to form an item of food for the lizard *Anolis cristatellus*.

Rogas nigristemmaticum Enderlein, doubtfully identified as to species by Mr. C. F. W. Muesebeck, was reared by Mr. Thos. H. Jones from larvae of the cane looper, *Mocis repanda* (F.), at Guánica in 1913, and was reported (Jones & Wolcott 1922–49) as a new species of *Rogas*, according to the original determination of the material by Mr. A. B. Gahan. This yellow wasp has since been collected in flight at Bayamón, but obviously is not common, and can hardly be an important factor in the control of its host.

Crassimicrodus fenestratus Viereck (1913-559), described from Puerto Rican material presumably collected at Mayagüez, is an entirely black wasp except for the scapula and tegula of the thorax, the abdomen and the distal half of the anterior femora. Its wings are dusky, except for two irregular cleared fenestrated areas in the forewings. It was most recently found in the screen trap in the garden at Hda. Santa Rita, Guánica, by Mr. E. G. Smyth. Nothing is known as to its host relationships.

Yelicones species, as identified by Mr. S. A. Rohwer, is a yellowish-brown wasp reared from the pupa of *Tetralopha scabridella* Ragonot. The caterpillars of this moth make so-called "butterfly nests" with the leaves of the coffee shade tree, *Inga vera*.

Macrocentrus ancylivorus Rohwer is an introduced Braconid released at Isabela in an attempt to control the lima bean pod-borers by natural means. It has not been recovered in the field. An endemic *Macrocentrus*, unidentified as to species, was reared by Mr. A. S. Mills from larvae of *Crocidosema plebeiana* Zeller in the seed heads of "escoba" (*Sida cordifolia*), and from the caterpillars of a Gelechid moth of the genus *Aristotelia* feeding on hibiscus at Vega Alta.

Phanerotoma planifrons Nees is another introduced parasite of lima bean pod-borers which has not been recovered in the field since the release of hundreds of adults at Barceloneta, Aguada and Guánica in June 1936. "The material originated in France and was shipped to the United States in the cocoon stage, where it was reared and shipped to Puerto Rico in the adult stage." Five thousand of these wasps were sent from Moorestown, New Jersey, over 96 percent of which reached Puerto Rico alive, but many of them died in large laboratory cages before release. An endemic *Phanerotoma*, unidentified as to species, has been intercepted on the leaves of *Adenanthera* at Bayamón.

Heterospilus etiellae Rohwer, an endemic parasite of one of the lima bean pod-borers, *Etiella zinckenella* (Treitschke), was first reported from Puerto Rico by Dr. M. D. Leonard and Mr. A. S. Mills (Jour. Ec. Ent., **24** (2): 466–473. Geneva, April 1931, see p. 470): a single specimen identified by Mr. A. B. Gahan. Several of these caterpillars taken from lima bean pods at Isabela in the summer of 1932 were noted with eight to ten dull pinkish maggots externally feeding on each until the caterpillar skin was sucked dry. Deserting the shrunken mummy the maggots spun whitish or brownish cocoons nearby, from which small yellow wasps emerged ten days later. These adults were identified by Mr. C. F. W. Muesebeck, as were others later reared from the same kind of caterpillars infesting the pods of *Crotalaria incana*. Actually, this wasp is of negligible importance in the control of its host, less than one percent of the caterpillars being attacked. Another endemic *Heterospilus*, unidentified as to species, has

been repeatedly intercepted: on guava at Bayamón and Arecibo, on grapefruit at Naguabo, Trujillo Alto and Arecibo.

Numerous other Braconids, identified only as to the genus, have been intercepted in Puerto Rico by various members of the personnél of the San Juan office of the Bureau of Entomology & Plant Quarantine. Mr. C. F. W. Muesebeck determined **Ascogaster,** from Caguas; **Hormius,** on leaves of lignum-vitae at Salinas; **Hoploteleia,** on leaves of almendro at Bayamón, and **Meteorus** and **Neoclinocentrus,** on leaves of *Adenanthera* at Bayamón.

A species of **Trigonophasmus,** as identified by Mr. Muesebeck, was collected by Dr. Luis F. Martorell in flight near the edge of the cliff on the Carmelita trail on Mona Island, April 1, 1940.

Ipobracon rimac Wolcott, a parasite of the caterpillars of the sugar-cane moth-borer, *Diatraea saccharalis* (F.), in Peru, was found in all the cane and corn fields in the region around Trujillo "in extraordinary abundance" by Mr. S. M. Dohanian (Jour. Agr. Univ. P. R., **21** (2): 237–241. Río Piedras, July 1927) during April and May 1936. To Puerto Rico he sent over ten thousand adults of this striking red and black wasp, but over two-thirds of them died en route, and no recovery has since been made in the field. The wasps are large and clumsy, and one might anticipate them as falling an easy prey to the active lizards of Puerto Rican cane fields. *Ipobracon amabilis,* in "seven shipments of sugar-cane borer parasites received from (São Paulo) Brazil" by Dr. K. A. Bartlett (Mayagüez Station Report for 1946, p. 31) was released at Hormigueros.

Bassus stigmaterus Cresson is another, but considerably smaller and less conspicuous, parasite of caterpillars of the sugar-cane moth-borer, *Diatraea saccharalis* (F.), which, under the name *Microdus diatraeae* Turner was first brought to Puerto Rico as pupae in cold storage by Mr. Harold E. Box from British Guiana in 1924 and 1925. The complicated story of "The Introduction of Braconid Parasites of *Diatraea saccharalis* Fabr., into Certain of the West Indian Islands" (Bull. Ent. Research, **18** (4): 365–370, pl. 1, fig. 2. London, May 1928) is not simplified by confusion in the identifications of the wasps concerned, but of this species, Mr. Box claims that "field recoveries were made of three cocoons and two parasitized borers during February and March 1925, and four more cocoons during December 1926, on one of the properties of Central Aguirre Sugar Company not far from where the original releases had been made". Additional introductions were made by Mr. S. M. Dohanian (1937-239) from British Guiana, 4.8% of subsequent parasitism being reported (Anon. 1938-97) by Dr. Kenneth A. Barlett at Hormigueros in January 1936. Subsequently, Dr. Bartlett introduced a new xerophytic race from São Paulo, Brasil, of which three adults were released at Santa Isabel (Anon. 1940-105), for, despite the record of recovery by Mr. Box at Aguirre, Dr. Bartlett wrote that

"*Bassus stigmaterus*, already occurring in Puerto Rico, is found in areas of high rainfall, but never on the south coast". The original identification of reared material from Hormigueros, made by Mr. C. F. W. Muesebeck, was *Bassus* (*Microdus*) *sacchari* Myers, but all of these names refer to a single, not very common wasp, of negligible economic importance in Puerto Rico as a parasite of the moth-borer, of which the most recent record is of finding a single adult in a cane field at Isabela. The persistent scarcity of *Bassus stigmaterus* in Puerto Rico is all the more surprising, not only because of its abundance in Cuba and South America, but when introduced into the cane-growing areas of southern Florida, it promptly became established, and, despite freezing winters, may parasitize 5% of moth-borer larvae in early spring, and after mild winters is often more than twice as numerous.

Ipobracon grenadensis Ashmead was first brought to Puerto Rico as reared pupal material from British Guiana in 1924 and 1925 by Mr. Harold E. Box. In 1926, while employed by Central Aguirre, he sent large numbers of these wasps from Venezuela, the work of rearing and shipping being continued by Mr. Luis A. Catoni. Despite the large numbers sent to Puerto Rico, this larger parasite of the caterpillars of the sugar-cane moth-borer, *Diatraea saccharalis* (F.), did not become established. Sixteen hundred adult females and many more males were sent from La Guayra to San Juan, over eighty percent of which survived the steamship trip for release at Aguirre, but not one wasp has since been seen in the field. The elapsed time en route varied from four to eight days, and involved hardships for the wasps that the present daily direct airplane flights would entirely avoid.

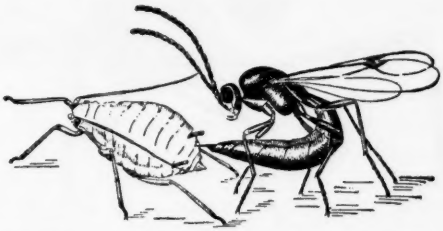
Mr. H. K. Plank, who for many years has been working on the powder post beetles of bamboo, reared from *Dinoderus minutus* F. a small brown wasp which was described by Mr. C. F. W. Muesebeck as one of "Two New Reared Species of *Doryctes* (Hymenoptera: Braconidae)" (Proc. Ent. Soc. Washington, **43** (7): 149–152. Washington, D. C., October 31, 1941) under the name **Doryctes parvus**. Mr. Plank noted (Anon. 1941-78) that "in Puerto Rico it appears to be relatively scarce and of little importance in the control of this beetle."

From a dead ucar (*Bucida buceras*) at Guánica infested with Anobiid beetles and their immature stages, *Petalium portoricensis* Fisher, in April 1940 Dr. Donald De Leon reared ten males and ten females of a wasp identified by Mr. C. F. W. Muesebeck as a new species of **Callihorminus**.

Rhyssalus brunneiventris Ashmead, as identified by Mr. C. F. W. Muesebeck, was first reared from the wedding cake scale, *Icerya montserratensis* Riley & Howard, at Pueblo Viejo by Mr. Francisco Seín, and has since been recovered from scale insect material from Isabela and Barceloneta. It occurs in considerable abundance, and may be the explanation

of the normal scarcity of this scale most of the time, interrupted by short-lived mass infestations on "laurel de la India" (*Ficus nitida*), as in the plazas of Caguas and Manatí. It is a small, bright yellow wasp, with lighter yellow legs, but with the eyes, antennae and wing veins black.

Aphidius testaceipes Cresson is a small, inconspicuous black wasp, rarely noted as an adult, but actually so common as often to parasitize practically all aphids on one host in a limited area. The often copied illustration, first published by Dr. F. M. Webster, shows the female in characteristic position facing the aphid, with her abdomen extended forward under her legs, the sharply pointed ovipositor piercing the rear of the aphid being parasitized. But a single egg is laid in the aphid by the wasp, and as the individual aphid is rather small for furnishing sufficient nourishment for the maggot of the wasp, the aphid is stimulated to grow much larger than it normally would. Such bloated aphids are most noticeable after the adult wasp has emerged, their dead, dry, papery bodies being pierced with



Aphidius testaceipes Cresson ovipositing in an aphid. (After Webster, U.S.D.A.)

a single round hole from which the wasp made its exit. In Puerto Rico, the presence of this parasite was first reported by Mr. Thos. H. Jones, attacking *Hysteroneura setariae* Thomas on sugar-cane, but it is not restricted to any particular species of aphid on any particular host plant. It has been noted here attacking *Aphis gossypii* Glover on "roble" (*Tabebuia pallida*) at Humacao, and on cucumber at Río Piedras and at Caguas; *Toxoptera aurantii* Fonscolombe on grapefruit leaves and on the leaves of "mamey" (*Mammea americana*) at Pt. Salinas; *Myzus persicae* Sulzer on egg-plant at Loíza, and undetermined aphids on orange, okra, sorghum and corn. Dr. F. M. Wadley (1937-106) noted its attack on the vector of mosaic disease of sugar-cane, *Aphis maidis*, and on *Hysteroneura setariae*. Under the generic name of *Lysiphlebus*, Mr. L. Courtney Fife (1939-9) reports parasitism on *Aphis gossypii* Glover on cotton.

Evaniidae

In addition to cockroaches scurrying for cover when a light is suddenly turned on in kitchen or garage, one may sometimes see a large shining

black wasp nervously running about, its long hind legs quite out of proportion to its stalked, short, laterally flattened, triangular abdomen. This is **Evania appendigaster** L., a specific parasite on the egg-clusters of the larger domestic cockroaches. Under the name of *Evania laevigata* Olivier, it is mentioned by Dr. Dewitz, and of it Dr. Gundlach states: "Se encuentra muchas veces en las casas, donde la larva se cría en las oötecas de las cucarachas". Only one wasp develops in all the eggs present in a single oötheca, and as the wasps, relative to the number of cockroaches, are quite abundant,

Evania appendigaster Linnaeus, five times natural size.
(Drawn by G. N. Wolcott.)

they are a factor of considerable importance in cockroach control, active in all parts of the Island.

Evania ruficaput, described by Dr. Hermann Dewitz (1881-205) from material collected by Dr. Gundlach at Mayagüez, has not since been noted.

Hyptia rufipectus, also described by him (1881-205) from specimens collected at Mayagüez by Dr. Gundlach, and **Hyptia petiolata** F., listed by him, Dr. Gundlach and Mr. W. M. Ashmead, have also eluded collection in recent years.

Brachygaster pygmaeus (F.), as determined by Mr. R. A. Cushman, is a small Evaniid wasp, with dark red head and prothorax, not a domestic insect and not found in houses, but sometimes noted in considerable abundance in the field, resting on leaves of sugar-cane, or of papayas, and most

recently on "palo de muñeca" (*Rauwolfia tetraphylla*) at Guayama. Nothing is definitely known as to its host relationships, but presumably it parasitizes the oötheca of small, wild, outdoor cockroaches.

Ichneumonidae*

Calliephialtes ferrugineus, described by Mr. R. A. Cushman as one of his "New Genera and Species of Ichneumon Flies, with Taxonomic Notes" (Proc. U. S. National Museum, **88** (3083): 355–372. Washington, D. C., 1940), on page 362, the type from Boquerón, was reared from larvae of the pink bollworm, *Pectinophora gossypiella* (Saunders), by Dr. K. A. Bartlett. In May 1940, Dr. Luis F. Martorell reared these wasps, one from each of two larvae of the mahogany shoot borer, *Hypsipyla grandella* (Zeller), in "cedro" (*Cedrela mexicana*) at Cayey, and others had previously been found in a grapefruit grove at Añasco, indicating an extensive distribution in Puerto Rico. As might be inferred from the specific name, the wasps are mostly ferrugineous in color, the head, scutellum and abdomen being definitely red, but with the white legs marked with black, the antennae and ovipositor-sheath black, the wings hyaline, "venetian black."

We are so accustomed to think of spiders as spinning webs in which to catch flying insects, or as jumping on unsuspecting terrestrial insects, that it at first seems a complete reversal of the natural order that some insects should attack spiders, or parasitize their eggs. Large slender wasps, with long brownish antennae, have been noted in the act of ovipositing in spider egg-masses, and if many of the egg-masses of some of the larger web-spinning spiders are collected, some of them may be found to be parasitized, as many as fourteen males and two females having been reared from one collected at Lares. This material was cited by Mr. Cushman (1940-363), who identified the wasps as the Cuban **Tromatobia lateralis,** described by Mr. E. T. Cresson "On the Hymenoptera of Cuba" (Proc. Ent. Soc., **4** (1): 1–200. Philadelphia, January 1865) on page 34 as a *Clistopyga*: "Honey

* To modernize the nomenclature of the Puerto Rican Ichneumonids, the following new synonymies and new combinations are proposed:

Pimpla rufoniger Cresson, 1865 = *Coccygomimus rufoniger* (Cresson), new combination.

Pimpla marginella Brullé, 1846 = *Coccygomimus marginellus* (Brullé), new combination.

Christolimorpha plesius Viereck, 1913 = (*Hemiteles*) *Christolimorpha fuscipennis* (Brullé, 1846), new synonymy and new combination.

Charops unicincta Ashmead, 1900 = *Charopsimorpha unicincta* (Ashmead); new combination.

Ophion concolor Cresson, 1865 = *Enicospilus flavus* (Fabricius), new synonymy.

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yellow, face and orbits white, antennae brown, abdomen ferrugineous, with five black spots on each side; wings hyaline, areolet triangular, slightly oblique; female length 4½ lines, ovipositor blackish, male length 3½ lines". They are identical with what Dr. Dewitz described (1881-205) from material collected at Mayagüez by Dr. Gundlach as *Ephialtes cressoni*, the name listed by Dr. Gundlach. They also occur on Mona Island, four large females and eight of the smaller and more slender males having been reared from several egg-masses covered with green silk of *Argiope argentata*, the large, silver-striped spider whose tough webs obstruct little-traveled paths between bushes and in the artificial forest back from the beach.

Coccygomimus marginellus (Brullé), listed as a *Pimpla* by Drs. Stahl and Gundlach, and by Ashmead, has not since been collected in Puerto Rico.

Coccygomimus rufoniger (Cresson), listed as a *Pimpla* ("IP Sup" 1924–36), collected by Mr. S. S. Crossman at Aibonito, has since been intercepted at Arecibo by Mr. A. S. Mills, and found on leaves of "maga" (*Montezuma speciosissima*) at Camp Doña Juana, Villalba by Dr. Donald De Leon.

Theronia nubecularia (Dewitz), described as a *Pimpla* (1881-206) from material collected at Mayagüez by Dr. Gundlach, and thus listed by him, is possibly what Dr. Stahl lists as *Pimpla bicinta* Cresson. No wasp answering to either description has since been found in Puerto Rico.

Labena sp. nov. was the identification given by Mr. R. A. Cushman to a wasp intercepted at light at Mayagüez.

Tryphon cerebrus Dewitz (1881-206), described from specimens collected by Dr. Gundlach, and listed by him, has not since been found.

Stiboscopus thoracicus Ashmead, incorrectly reported (Wolcott 1937–144) as a not very common parasite of the coffee leaf-miner, *Leucoptera coffeella* (Guérin-Méneville), from Lares, has been repeatedly intercepted in the high mountainous forests and in coffee groves, on El Yunque, at Adjuntas and Villalba, and even at light at Bayamón. Its true host relationship was shown when Dr. Luis F. Martorell reared it from *Apanteles* cocoons developing on the outside of the tobacco hornworm, *Phlegethontius sexta jamaicensis* Butler, but as all cocoons were parasitized, the species of *Apanteles* attacked is uncertain.

A wasp intercepted on almendro at Bayamón, originally determined as a species of *Allocota*, Dr. H. K. Townes now calls a species of **Phobetes.**

Christolimorpha subflavescens (Cresson), listed by Dr. Stahl as a *Hemiteles*, is considered by Dr. H. K. Townes to be what Drs. Dewitz and Gundlach list as *Hemiteles incertus* Cresson. A single male has since been collected at Ciales, in a coffee grove. In general color it is "rufous; antennae and abdomen black, the latter banded with white, metathorax with two long acute white spines, wings clouded, iridescent" to quote Mr. Cresson, who continues that "this species answers in some respects to the descrip-

tion given of *H. fuscipennis* Brullé, from Hayti, but I am uncertain of their identity. It may be only a variety of that species. Prof. Poey informs me that this species devours the chrysalis of his *Pyralis flegialis*." Haitian females lack the "two long acute white spines," but possess a long black ovipositor-sheath and rufous ovipositor.

Christolimorpha fuscipennis (Brullé) is considered by Dr. H. K. Townes to be what Mr. H. L. Viereck (1913-564) described as *C. plesius*, the type from Mayagüez, where it has since been intercepted by Mr. A. G. Harley. It has also been intercepted at San Juan, and on mango flowers at Bayamón, according to re-determination of the material by Dr. Townes, as well as at Ciales, Morovis, Villalba and Maricao.

Acroricnus cubensis (Cresson), as determined by Mr. R. A. Cushman, was reared by Mr. Francisco Seín as a parasite of the mud-dauber wasp, *Eumenes ornatus* Saussure, one of the parasitic wasps emerging from each cell of the nest. In general color, this large wasp is more black or dark than as described by Mr. Cresson (as a *Cryptus*): "yellowish, shaded with dusky; sides of mesothorax, base of metathorax, hind legs in part and three basal segments of abdomen, black; wings yellowish hyaline." In Cuba "this species is parasitic on the larva of *Pelopoeus lunatus* Fab.," another mud-dauber wasp. Wasps twice intercepted on mango trees at Trujillo Alto have been identified as being a species of **Messatoporus,** and others on weeds at Bayamón as a species of **Amblyteles.**

Carinodes havanensis (Cameron), a large wasp with black head and thorax spotted with yellow, shining chestnut abdomen and legs, was first collected in Puerto Rico by Dr. C. W. Hooker at Mayagüez, and one specimen has since been found at Río Piedras. Nothing is known of its host relationships.

Limonethe meridionalis (Cresson), a continental species described originally as an *Ichneumon*, and thus listed from Puerto Rico by Dr. Stahl, is "black; antennae with a white annulus, wings fuscous; abdomen, except first segment, rufous; central area of metathorax large, subquadrate, indistinct, length 5½ lines." As a *Tetragonchlora* it was identified by Mr. R. A. Cushman for Dr. Richard T. Cotton, who swept it from weeds at Río Piedras. More recently, specimens found on weeds at Río Piedras, and intercepted at Santurce and Aibonito, have been re-studied by Dr. H. K. Townes who thinks they represent "a distinct endemic species."

Lissonota sp. was the determination by Mr. R. A. Cushman of a wasp reared from a pupa of the bucare stem-borer, *Agathodes designalis* Guenée, at Cayey.

Stenomacrus sp. was the identification by Mr. R. A. Cushman of wasps intercepted on grapefruit at Naguabo and resting on *Adenanthera pavonina* at Bayamón.

Eiphosoma annulatum Cresson, a very slender yellow wasp, narrowly striped or banded with black, and with a very long and slender, deeply arched abdomen, "shaped somewhat like an inverted cimeter," was listed from Puerto Rico by Drs. Dewitz, Stahl and Aldrich, and Dr. Gundlach reports it "en Utuado". It is not noticeably a mountainous species, as this might indicate, for later collections have been made at Río Piedras, Aguadilla, Salinas, Guayanilla and Guánica. Mr. Cresson states that "Prof. Poey informs me that this species is 'parasitic upon a larva of *Pyralis*,'" and Mr. E. G. Smyth at Guánica "reared it from a leaf-roller larva."

Eiphosoma insularis Viereck (1913-564), an endemic species, was reared by Mr. Thos. H. Jones at Río Piedras from the tobacco "pega-pega," *Psara periusalis* (Walker), and by Dr. Donald De Leon at Patillas from the péndula leaf-roller, *Pyrausta cerata* (Fabricius).

Eiphosoma nigrovittatum Cresson, listed from Puerto Rico by Drs. Gundlach, Dewitz and Ashmead, has since been swept from carrots at Río Piedras by Dr. Richard T. Cotton.

Eiphosoma vitticollis Cresson, found at Guánica, is somewhat larger than the others, and less black, "the metathorax having only a central black line," and "the narrow dorsal surface (of the abdomen is) blackish."

Cremastus sp., spp. or sp. nov., as determined by Mr. R. A. Cushman, has been repeatedly intercepted: on weeds at Pueblo Viejo and Dorado, on milkweed flowers and crotalaria flowers at Bayamón, and on kunquat at Arecibo.

Idechthis canescens (Gravenhorst) was intercepted resting on bananas in a boat in San Juan harbor.

Charopsimorpha unicincta (Ashmead) has been intercepted at San Juan.

Ophiopterus cincticornis (Cresson), listed from Puerto Rico by Dr. C. W. Hooker as *Ophiopterus ferrugineus* (Cresson) on p. 94 of "The Ichneumon Flies of America belonging to the Tribe Ophionini" (Trans. Amer. Ent. Soc., **38** (1 & 2): 1–176, pl. 3, fig. 18. Philadelphia, June 12, 1912), has not since been found here.

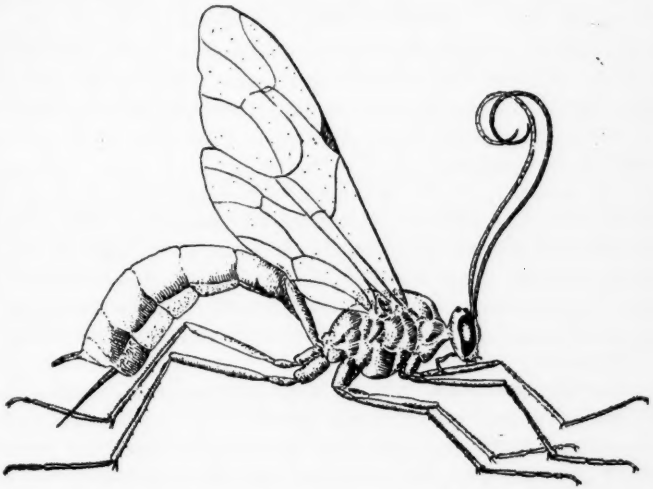
Ophion ancyloneura Cameron has been repeatedly intercepted at light, at San Juan and at Bayamón.

Ophion bilineatus Say, a very large yellow wasp with flattened, cimeter-shaped abdomen, was listed from Puerto Rico by Dr. C. W. Hooker (1912-45), and a specimen subsequently collected at Guánica by Mr. G. B. Merrill was identified as this species by Mr. R. A. Cushman. Others in the Río Piedras collection which appear to be the same were found at light at Río Piedras and at Arecibo. This is a continental species, "length 10–20 mm., varying in color from pale yellowish to reddish brown; one of the commonest species, occurring throughout boreal North America, parasitic on the larvae and pupae of a large number of Lepidoptera, including *Telea polyphemus*

(Cramer), *Samia cecropia* (Linn.), and other arctiid and noctuid moths", according to Dr. E. O. Essig (1926-792).

Ophion biangularis Taschenberg is the identification of a wasp for Mr. R. H. Van Zwaluwenburg, collected at Mayagüez and listed by him (P. R. 1026).

Ophion bicarinatus Cresson and *Ophion obsoletus* Cresson are MS names of Ichneumonid wasps collected at Mayagüez by Dr. Gundlach and listed by him as such.



The Ichneumonid wasp *Ophion* sp., about four times natural size. (Drawn by Fritz Maximilien.)

Pristomerus sp. is the identification by Mr. R. A. Cushman of a wasp found by Dr. Luis F. Martorell on flowers of "corcho" (*Pisonia albida*) on the Carmelita trail, Mona Island on April 2nd, 1940.

Enicospilus angulatus, described as an *Eremotylus* by Dr. C. W. Hooker (1912-144), the type from Mayagüez, was subsequently reared by Mr. R. H. Van Zwaluwenburg from the larva of *Ecpantheria icasia* (Cramer), and listed by him (P. R. 5037).

Enicospilus arcuatus (Felt) was the identification received by Mr. S. S. Crossman of an Ichneumonid wasp which he had collected at Aibonito.

Enicospilus concolor (Cresson), listed by Van Zwaluwenburg (P. R. 1028) from Mayagüez, has since been swept from grass at Río Piedras, and intercepted at light at Bayamón, and resting on lime at Dorado.

Enicospilus flaviceps (Brullé) was intercepted at light at Bayamón.

Enicospilus flavus (F.), was noted by Dr. Gundlach as "común," and listed by Dr. Stahl as on *Ophion*, and by Mr. R. H. Van Zwaluwenburg as P. R. 1027.

Enicospilus purgatus (Say) is in Van Zwaluwenburg's list as P. R. 1029.

Enicospilus thoracicus (Cresson), listed from Puerto Rico by Dr. Gundlach as an *Ophion*, was reared from the tobacco hornworm, *Phlegethontius sexta jamaicensis* Butler, by Mr. R. H. Van Zwaluwenburg, and listed by him as P. R. 5083.

CYNIPOIDEA: Figitidae

Long before the intensive investigation on fruitflies had been initiated by the Bureau of Entomology & Plant Quarantine in Puerto Rico, Dr. C. W. Hooker (1913-36) had reared a previously unknown Figitid wasp from the larvae of what he referred to as *Anastrepha fraterculus* Wied., now called *Anastrepha mombinpraeoptans* Seín, in the fruit of "jobo" or hog plum (*Spondias mombin*). In the same year, this wasp was included by Mr. J. C. Crawford in his "Descriptions of New Hymenoptera" (Proc. U. S. National Museum, **45** (6): 241–260. Washington, D. C., May 22, 1913) as **Ganaspis hookeri**. It is not very abundant, and presumably is a very minor factor in the control of fruitflies, but has since been reared from their maggots in oranges, and from those in the much smaller fruit of an imported tree, *Euphoria didyma*.

Eucoila (**Hexamerocera**) **atriceps** Ashmead, and, as determined by Mr. L. H. Weld, another species of this genus, are somewhat more abundant as parasites of both *Anastrepha mombinpraeoptans* Seín and *Anastrepha suspensa* Loew maggots, having been reared from fruit of "jobo" and of "pomarrosa" (*Eugenia jambos*) collected at Mayagüez, Las Vegas, San Sebastián, Caguas and Loíza. They have also been reared from cornsilk maggots, *Euxesta stigmatias* Loew.

Xyalosema (**Aspicera**) **bifoveolata** Cresson, as identified by Mr. J. C. Crawford, was reared by Mr. G. B. Merrill at Guánica from hornfly puparia when he was investigating possible natural factors in the control of this accidentally introduced pest. This wasp was originally described from Cuba, possibly before the horn fly had been introduced there, as "black; antennae and legs honey-yellow; wings hyaline, scutellar spine acute; length 1 line" from a single specimen collected by Dr. Gundlach. Dr. Gundlach did not find it in Puerto Rico, or at least left no record of collecting it here.

CHALCIDOIDEA: Agaonidae

In California, where commercial varieties of fig trees grow well, no fruit was produced on the thriving trees until the fig wasp, *Blastophaga psenes*

(L.), was introduced from Smyrna in 1890. Upon the presence of this minute wasp, the entire commercial Smyrna fig industry of California depends, as is told in detail by Dr. I. J. Condit in "Caprifigs and Caprification" (Bulletin No. 319, California Agr. Expt. Station, 1920). No such importations would be necessary into Puerto Rico to ensure the setting of fig fruit, for two species of Agaonid fig wasps are already present here. **Blastophaga insularis** Ashmead and **Secundeisenia mexicana** Ashmead, as identified by Mr. A. B. Gahan, have been intercepted on trees of wild fig or "jagüey" (*Ficus laevigata*) between Manatí, Ciales and Arecibo. It may be presumed that these wasps are present thruout the Island, and also that they or other species ensure the fertilization of the large hollow fruit of the climbing fig (*Ficus pumila*) or the smaller but much numerous fruits of the "laurel de la India" (*Ficus nitida*), altho none has been noted on these other figs.

Mymaridae

Anagrus armatus Ashmead, as determined by Mr. A. A. Girault, is a very small Mymarid wasp which is parasitic on the eggs of *Delphax saccharivora* Westwood, the sugar-cane "fly" which is really a Fulgorid planthopper. This is at times a very serious pest of sugar-cane in Jamaica and Barbados, feeding on the underside of young leaves, and sometimes so abundant as to kill out young cane and render replanting impossible. In Puerto Rico outbreaks are unknown, altho the planthopper occurs in small numbers in cane fields in all parts of the Island. Its continued scarcity is due, in part at least, to natural control by this insignificant wasp. The parasitic wasp also attacks the egg-masses of other leafhoppers in grasses, but recent rearings have not been made to determine the specific identity of its alternate hosts.

The wasp reared by Mr. A. S. Mills from some insect occurring on *Pluchea purpurascens* at Pt. Cangrejos has been identified by Mr. A. B. Gahan as a new species of **Polynema**.

Alaptus borinquensis, reared by Dr. H. L. Dozier from the pustule scale, *Asterolecanium pustulans* (Cockerell), on "caña fístula" (*Cassa fistula*), was included in his "Description of New Mymarid Egg Parasites from Haiti and Puerto Rico" (Jour. Dept. Agr. P. R., **16** (2): 81–91. San Juan, April 1932): "a very variable species in size; general color dark brown, the antennae and legs light brown, the pedicel slightly paler."

Alaptus caecillii Girault was determined by Mr. C. F. W. Muesebeck over twenty years after it had been reared by Mr. Thos. H. Jones from what he considered to be a Psocid egg-mass on sugar-cane.

Mymar antillanum, included by Dr. H. L. Dozier in his "Descriptions of miscellaneous Chalcidoid Parasites from Puerto Rico (Hymenoptera)"

(Jour. Agr. Univ. P. R., **21** (2): 121–135. San Juan, April 1937), the type female collected by him "sweeping grasses and sedges at roadside pond edge near Boquerón," is not confined to the semiarid southwestern corner of the Island, for altho others were found on the margin of Guánica Lagoon, he made additional collections of this dark brown wasp at Mayagüez and at 1,000 feet elevation in a coffee grove at Las Vegas.

Gonatocerus portoricensis Dozier (1937-131) may be "distinguished at once by its yellowish-orange abdomen, transversely banded with brown," the type from Isabela, but other specimens were found by Dr. Dozier at numerous points on the western and southern coast of Puerto Rico.

Gonatocerus antillensis Dozier (1937-132) was described from females collected at Mayagüez or nearby.

Erythmelus longicornis Dozier (1937-133) may be "recognized easily by the unusually long antennae and the pale, dirty yellowish legs": the type a single female from Maní beach near Mayagüez.

Erythmelus miridiphagus Dozier (1937-133) has "shorter antennae, fuscous legs", and was found in large numbers in a pure stand of *Amaranthus* heavily infested with Mirid bugs: *Polymerus cuneatus* Distant, at Hormigueros.

Erythmelus nanus Dozier (1937-134) is a short, compact wasp, mostly black but with the "basal third of the abdomen whitish", the type from Las Vegas, others from Guanajibo.

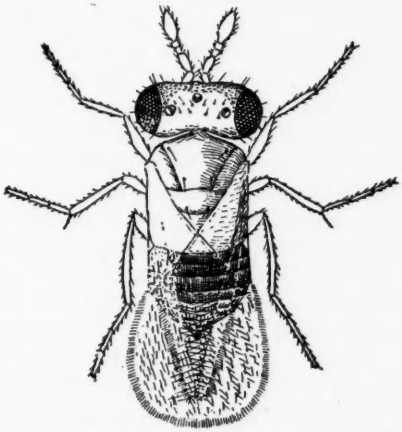
Trichogrammidae

Trichogramma minutum (Riley), a minute little yellowish wasp with pink eyes and brownish abdomen, a tropicosmopolitan parasite on the eggs of many kinds of butterflies and moths, is possibly best known in Puerto Rico because it attacks the eggs of the sugar-cane moth stalk-borer, *Diatraea saccharalis* (F.). Altho almost microscopic in size, it is readily visible against the creamy yellow of the moth-borer egg-cluster, where it has repeatedly been observed in the field. Eggs turn black the next day after they have been parasitized, and continue to be dark even after the parasites have emerged, usually about two weeks later. Each *Diatraea* egg contains sufficient nourishment for the complete development to adult of one parasite wasp.

In Puerto Rico, *Trichogramma* has been reared not only from the somewhat similar eggs of *Etiella zinckenella* (Treitschke) and *Psara periusalis* (Walker), but also from the skipper butterfly eggs of the canna leaf-roller, *Calpodes ethlius ethlius* (Cramer), and from other skipper butterfly eggs on sugar-cane. The possibility of producing large quantities of these parasites in the laboratory, however, depends upon the ease with which *Trichogramma* may be reared on the eggs of the Angoumois grain moth, *Sitotroga*

cereallela (Olivier), and these loose eggs glued to a cardboard sheet, paper cup or glass jar, for transportation to the cane field just as the parasites are about to emerge. The ability thus to control a laboratory-reared supply of parasites for release when and where needed seems to indicate a really practical method of using natural parasites as effectively for pest control as one might apply poisonous insecticides by means of a spray pump.

Extensive experiments with field liberations indicate that many unexpected difficulties limit such practical applications. "Natural Parasitism by *Trichogramma minutum* in the Eggs of the Sugar-Cane Moth Borer, *Diatraea saccharalis*, in the Cane Fields of Puerto Rico" (Jour. Agr. Univ. P. R., **27** (2): 39–83, fig. 1, pl. 6, ref. 14. Río Piedras, April 1942) is nor-



Trichogramma minutum (Riley), eighty-five times natural size. (Drawn by G. N. Wolcott.)

mally high during all the warmer part of the year, especially in ratoon fields in which the trash has not been burned, and in the more humid parts of the Island. In the eastern end of Puerto Rico, egg-clusters of *Diatraea* so rarely occur in abundance that the parasite continues existence most precariously, and nothing is to be gained by releasing additional parasites. Even in the most xerophytic parts of the Island, most fields of gran cultura cane have an abundance of egg-clusters, and also of parasites during the coolest part of the year. But especially in the Santa Isabel region, and to a lesser extent all along the south coast, the cooler temperatures of late fall, winter and early spring seem to eliminate *Trichogramma* from some fields of plant cane, and in these fields the release of laboratory-reared parasites is beneficial. Regardless of the reason why the parasites did not naturally

occur in a particular cane field, if unparasitized egg-clusters were present in abundance, the laboratory-reared parasites promptly attacked them, often making their artificial parasitization as high or higher than in other fields in the region where no parasites had been released. Thus the problem of using *Trichogramma* effectively is resolved into that of finding promptly these fields where fresh egg-clusters are abundant but little or no natural parasitism occurs. Any other method of using *Trichogramma*, by mass releases in *all* fields at the seasons and in the regions where only a few fields are deficient in parasites, involves a very considerable waste of the parasites, even tho it is possibly the most practical, and indeed has been adopted in other countries where this method of control of the sugar-cane moth-borer has been attempted on a large scale.

Long before anyone had suggested the use of laboratory-reared *Trichogramma*, the importance of this parasite in cane fields had been recognized, and observations made on it in relation to "The Influence of Rainfall and the Non-Burning of Trash on the Abundance of *Diatraea saccharalis*" (Circ. No. 7, Insular Experiment Station, pp. 6, fig. 1. San Juan 1915). While rainfall was shown to have exerted a greater effect on the amount of damage caused by moth-borer caterpillars to mature cane stalks as brought to the mill, damage averaged higher to plant cane and to ratoon cane of which the trash had been burned when the previous crop was harvested. It was thought that this was due to the comparative slowness with which the parasite dispersed into such fields, as contrasted with its normal presence in abundance, little disturbed by harvesting, in fields where the trash had not been burned. "The Extent to which the Practise of Not Burning Cane Trash has been adopted in Puerto Rico" (Jour. Dept. Agr. P. R., **17** (3): 197–8. San Juan, November 1933) gives some indication of how the benefits of having an abundance of *Trichogramma* naturally present in cane fields may be obtained, at least in part, without the expenditure of time and money involved in the use of laboratory-reared parasites, merely by the adoption of the field practise of not burning trash.

Xenufens ruskini Girault, as determined by Mr. A. B. Gahan, is another Trichogrammid parasite of the eggs of skipper butterflies on sugar-cane, in addition to *Trichogramma minutum*. As a result of the combined attack of these two Trichogrammid wasps, plus that of an Encyrtid wasp which was described by Mr. Gahan (1944-137) under the name of *Oöencyrtus prenidis*, "from October to February, when eggs are most numerous, two-thirds or more of all eggs collected are black with parasitism, and all of the smaller number of eggs during the summer are parasitized." In making observations on "The Seasonal Cycle of Insect Abundance in Puerto Rican Cane Fields" (Jour. Agr. Univ. P. R., **27** (2): 85–104, fig. 12, ref. 16. Río

Piedras, April 1942) "not a single caterpillar was noted from April to September" during the five years in which the leaves of young plant and ratoon cane were watched: surely a most effective demonstration of how potentially serious pests may be kept to a minimum by natural parasite control.

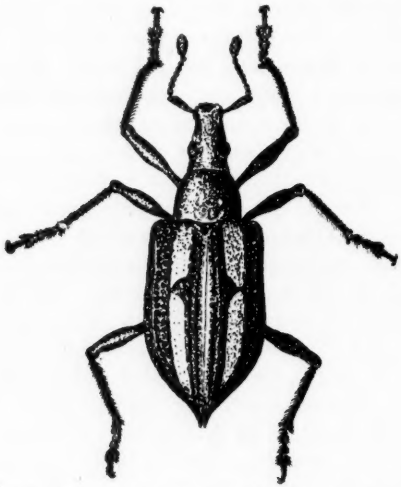
Poropoea attelaborum Girault, as determined by Mr. A. B. Gahan, is a small black wasp which attacks the egg of guava leaf-roller, *Euscelus bipustulosus* Jekel, despite the supposed protection under several layers of rolled-up leaf. Apparently it is an important factor in limiting the abundance of this most interesting beetle.

From the eggs of leafhoppers in the leaves of sugar-cane and other grasses, Mr. Thos. H. Jones reared a number of parasites which were identified by Mr. A. A. Girault as **Brachistella prima** Perkins, **Ufens niger** Ashmead, **Oligosita comosipennis** Girault and **Aphelinoidea semifuscipennis** var. **albipes** Girault. No similar competent specialist in the identification of leafhoppers was available at that time, and it can merely be conjectured that the host was what was then known as a *Kolla* or *Cicadella*, now called *Hortensia similis* (Walker). Nor has anyone since attempted such large scale rearings, and the **Oligosita magnifica** which Dr. H. L. Dozier (1937-135) described from specimens at Cartagena Lagoon, Boquerón and Bayamón, was not reared, and its host is unknown. Twenty years after Mr. Thos. H. Jones had reared a parasite from the eggs of the common *Ormenis* planthopper, Mr. C. F. W. Muesebeck identified it as a species of **Abbella.**

Ufens osborni Dr. H. L. Dozier included in his "Descriptions of New Trichogrammatid (Hymenoptera) Egg Parasites from the West Indies" (Proc. Ent. Soc. Washington, **34** (3): 29–37. Washington, D. C., March 1932), from material "reared by Herbert T. Osborn at Central Aguirre, P. R., in 1930 from the eggs of the Sugar Cane Root Weevil, *Diaprepes abbreviatus* L." It is apparently only a secondary parasite, attacking eggs previously parasitized by *Tetrastichus haitiensis* Gahan. Even thru the surrounding egg-shell of the host one can plainly see the pink eyes and yellow body of the parasite, very different from the black of the primary parasite. The evidence regarding whether *Ufens osborni* is a primary or secondary parasite is, however, somewhat conflicting, but before any such doubts arose, Mr. R. W. E. Tucker attempted, unsuccessfully, to introduce it into Barbados. According to Mr. R. G. Fennah, who conducted "The Citrus Pests Investigation in the Windward & Leeward Islands, British West Indies, 1937–1942" (pp. 66, pl. 2, ref. 20. Imperial College of Tropical Agriculture, Trinidad, August 1942), *Ufens osborni* occurs in Montserrat, but other species of *Ufens*, differing markedly from each other, occur in Dominica and St. Lucia, both of which he considers primary parasites of *Diaprepes* eggs, but competitive with *Tetrastichus haitiensis.*

Tetrastichidae

The common large leaf weevil of Hispaniola, black with pink or yellow stripes on the elytra, *Prepodes quadrivittatus* Olivier, is often as abundant there as *Diaprepes abbreviata* (L.) is in Puerto Rico, and is its perfect analogue in the number and variety of hosts, the leaves of which it will eat and between which it oviposits. When life-history studies on it were commenced, most of the egg-clusters between citrus leaves were found to be parasitized, the wasps emerging thru the holes which they make in the



Prepodes quadrivittatus Olivier, the Hispaniolan Weevil from whose eggs *Tetrastichus haitiensis* Gahan was reared. Twice natural size. (Drawn by Fritz Maximilien.)

leaves being promptly described by Mr. A. B. Gahan (Proc. Ent. Soc. Washington, **31** (1): 17. Washington, D. C. January 1929) as **Tetrastichus haitiensis.** It seems incredible that these parasitic wasps had not previously been found in Puerto Rico, where they are so abundant in late spring as to form an appreciable item in the food of arboreal lizards, and are in fact the principal factor in the control of the vaquita, *Diaprepes abbrevita* (L.). They are so numerous indeed during April, May and June, when most *Diaprepes* eggs are laid, that practically all egg-clusters are parasitized at that time. The female vaquitas begin oviposition between the tougher and older leaves of preferred host trees within a few days after their emergence from their pupal cell in the soil, thus survival of *Diaprepes* largely depends upon the egg-clusters laid at other times of year, when the

parasites are scarce. Thus, "deviation from a one-year life-cycle is of tremendous value to *Diaprepes abbreviatus* L., in enabling its eggs to escape attack by the parasitic wasp, *Tetrastichus haitiensis* Gahan, which is most abundant during the late spring, but very scarce during autumn and winter," as was shown in studies on "The Life-History of *Diaprepes abbreviatus* L., at Río Piedras, P. R." (Jour. Agr. Univ. P. R., **20** (4): 883–914, fig. 5, ref. 21. Río Piedras, October 1936).

Tetrastichus haitiensis Gahan. Sixty times natural size. (Drawn by G. N. Wolcott.)

In Cuba, *Testrastichus haitiensis* and *Ufens osborni* have been reared from the eggs of the "verde-azul," *Pachnaeus litus* (Germar). In the Lesser Antilles, eggs of the endemic species of *Diaprepes* are attacked. In Barbados, however, *Tetrastichus haitiensis* does not occur, and an attempt was made to introduce it there. The ostensible cause of failure was the difficulty experienced by the wasps in piercing the tough tips of cane leaves, where only do the Barbadian weevils lay their eggs. Parasitized egg-clusters have been found between the tips of cane leaves in Puerto Rico, but so rarely as to indicate that a real protection to the eggs is thus afforded, not furnished by tender citrus or wild fig leaves.

Tetrastichus vaquitarum Wolcott ("IP" 1923–63), reared from the eggs

of the coffee vaquita, *Lachnopus coffeae* Marshall at Indiera, in the high mountains between Yauco and Maricao in June 1921, is very different in appearance from the all black wasps attacking the eggs of the larger vaquitas, for it has a yellow head with chestnut red ocelli and eyes. No collection, subsequent to that of the type, has been made in Puerto Rico, or elsewhere.

Tetrastichus hagenowi (Ratzeburg), originally indentified from Puerto Rico by Mr. J. C. Crawford, has been repeatedly reared from tough leathery oöthecas of the big domestic cockroach, *Periplaneta americana* L. The similar Australian cockroach, *Periplaneta australasiae* (F.), is "para-

Tetrastichus vaquitarum Wolcott. Fifty times natural size. (Drawn by G. N. Wolcott.)

site-free", according to Mr. H. K. Plank (1947-12). The very tough and sticky glue used by vaquita weevils to cement together two leaves over their egg-clusters fails to prevent parasitism, as does the even harder leathery covering of the cockroach egg-mass, from this small wasp and the large black Evaniid wasps, as previously noted. From a single cockroach egg-capsule, laid in captivity, 71 adults of these smaller wasps emerged, indicating that several must have developed in each cockroach egg, and also proving that this is, or may be, a primary parasite.

Tetrastichus periplanetae Crawford, as identified by Mr. A. B. Gahan, has also been reared from the egg-capsule of a domestic cockroach. Both of these cockroach parasites have been collected in the field, as well as around kitchens and garages infested with cockroaches.

Tetrastichus tatei **is the name given by Dr. H. L. Dozier (1937-129),**

re-describing **Tetrastichus thripophonus** Waterston of Trinidad, to the wasps he reared "from swollen last instar nymphs of *Gynaikothrips uzeli* (Zimm.) curling the foliage of Cuban laurel, *Ficus nitida*, on the Experiment Station grounds at Mayagüez, P. R., March 26–April 5, 1936." The males of this parasite are unknown, but the females, slightly over 1.0 mm. in length are "dark brown in color, the eyes conspicuously red, with the antennae and legs yellowish-testaceous, and a light or clear median area occupying over a third of the abdomen at base." The synonymy of this thrips parasite, now known to occur also in Florida, is pointed out by Dr. B. D. Burks in his paper on "The North American Parasitic Wasps of the Genus *Tetrastichus*—A Contribution to Biological Control of Insect Pests" (Proc. U. S. National Museum, **93** (3170): 505–608, pl. 6. Washington, D. C., 1943), who notes that it has been reared also from prepupae of *Liothrips laureli* (Mason) and *Liothrips urichi* Karny, as well as from what is now known as *Gynaikothrips ficorum* Marchal.

"During the spring of 1940 while residing at Río Piedras," Prof. James G. Needham became very much interested in the "Insects from Seed Pods of the Primrose Willow, *Jussiaea angustifolia*" (Proc. Ent. Soc. Washington, **43** (1): 2–6, fig. 1. Washington, D. C., January 1941), and from cages containing galls caused by *Ceratoneura femorata* (Ashmead) took a male and a female of **Tetrastichus marylandensis** (Girault). This species, whose "body is usually almost entirely yellow" had previously been recorded from Puerto Rico by Dr. F. M. Wadley in his "Observations on some Insects associated with Sugarcane in Puerto Rico" (Jour. Agr. Univ. P. R., **21** (2): 103–114, ref. 15. Río Piedras, April 1937) as a parasite of the corn aphis, *Aphis maidis* Fitch. In the Lesser Antilles, Mr. R. G. Fennah (1942-15) found this species attacking the eggs of the endemic species of *Diaprepes*, and noted that "in *Tetrastichus marylandensis* it seems more usual for the larvae to eat their way out of the *Diaprepes* egg when ready to pupate, and to take a position at right angles to the periphery of the former egg-cluster. Thus the pupae are grouped radially, sometimes in perfect formation."

Tetrastichus antiguensis Crawford, as doubtfully identified by Mr. C. F. W. Muesebeck, was reared by Mr. Thos. H. Jones from the leaves of *Piper* sp. infested with larvae of the leaf-miner, *Tischeria heliopsisella* Chambers, on El Yunque.

Other species of *Tetrastichus*, unidentified as to species, have been reared from material of the coffee leaf-miner, *Leucoptera coffeella* (Guérin-Méneville); from galls on "corcho" (*Torrubia fragrans*) at Isabela, and on "laurel blanco" (*Nectandra sintenisii*) at Patillas by Dr. Luis F. Martorell; from the fruit of *Casearia decandra* intercepted at Vega Alta; besides one which Mr. J. A. Ramos collected at light on Mona Island.

Syntomosphyrum species is the determination by Mr. A. B. Gahan of

hyperparasitic wasps emerging from *Apanteles* cocoons on the larvae of a leafwebber, *Phostria martyralis* (Lederer), collected by Dr. Luis F. Martorell on "genogeno" (*Lonchocarpus domingensis*) at Guayanilla.

Ceratoneura femorata (Ashmead), which Prof. James G. Needham (1941–4) reared from galls of the primrose willow, is the only phytophagous, gall-producing Eulophid known from Puerto Rico. Mr. A. B. Gahan (Proc. Ent. Soc. Washington, **43** (1): 1–2. Washington, D. C., January 1941) states that this species was originally described from the island of St. Vincent as a *Tetrastichodes*, with no indication as to its habits.

Ceratoneura petiola Ashmead, as determined by Mr. C. F. W. Muesebeck, was reared by Mr. Thos. H. Jones from a little weevil in portulaca which Dr. E. A. Schwarz had doubtfully identified as a species of *Hypocoeliodes*, or possibly *Hypurus*, near *bertrandi* Perris.

Entedontidae

Chrysocharis parksi Crawford, as determined by Mr. C. F. W. Muesebeck, has been repeatedly reared from the larvae of the Agromyzid leaf-miner of peas and beans, and another species of *Chrysocharis* has been reared (Anon. 1939-108) from the larvae of the Pyralid leafwebber of beans, *Lamprosema indicata* (F.).

Chrysocharis lividus Ashmead was first reared as a parasite of the coffee leaf-miner, *Leucoptera coffeella* (Guérin-Méneville), by Mr. O. W. Barrett, the first Entomologist at the Mayagüez Station. This wasp he described (*in* Annual Report P. R. Agr. Expt. Station for 1904, p. 397. Washington, D. C., 1905) as being "black with purplish reflections from the thorax; the size about 1.0 mm.; very active," and by the next year found that it was common "throughout the island." Mr. Francisco Seín has painted, approximately five hundred times life size, representations in color of both the male and female of this wasp, which well indicate how different in appearance are the two sexes. The wasps are black only on the basal segments of the legs, but the tarsi and tips of the tibiae are white. The female is much plumper, being various shades of orchid and purple, the slender male is mostly greenish, the basal half of the abdomen being transparent and startlingly lighter in color. This parasite of the coffee leaf-miner does occur everywhere on the Island that coffee is grown, but it is much more abundant at Mayagüez, where Mr. R. H. Van Zwaluwenburg in 1933 found thirty percent of parasitism, than at higher elevations only a few miles away, where barely one percent of the leaf-miner larvae may be attacked.

The intensive rearing by Mr. Francisco Seín of the coffee leaf-miner indicates that *Chrysocharis lividus* is only one out of many attacking it in Puerto Rico. Of the less common parasites, Mr. A. B. Gahan has identi-

fied **Proacrias coffeae** Ihering, a species of **Derostenus** "near *fullawayi* Crawford," and a species of **Closterocerus** "near *cinctipennis* Ashmead."

The green **Closterocerus leucopus** Ashmead proves to be one of the most abundant parasites generally, especially in the mountains.

Horismenus cupreus Ashmead, a plump, iridescent coppery-green wasp with red eyes, and legs black except for white tarsi and white ends of the tibiae, is possibly third in abundance in the mountains. Of it, Mr. Seín has made a five hundred times life-size painting in color.

Horismenus eudami (Girault), in Cuba reared as a hyperparasite of *Apanteles leucostigmus* Ashmead, attacking the bean leaf-roller, a skipper butterfly formerly called *Eudamus*, but now *Urbanus proteus* (L.), has been reared from these caterpillars in Puerto Rico with no indication that it is not a primary parasite. Dr. L. O. Howard himself identified the material, which had been reared by Dr. Richard T. Cotton.

Another species of **Horismenus,** not identified as to species, has been reared from cocoons of *Apanteles americanus* (Lepeletier) intercepted at Vega Alta.

From vaquita egg-clusters parasitized by *Tetrastichus haitiensis* Gahan, a hyperparasite has been reared, identified by Mr. A. B. Gahan as another species of **Horismenus,** "very similar to (*Pseudomphale*) *graciliventris* (Girault)."

From pods of *Prosopis juliflora* and *Acacia farnesiana* infested with the Bruchid beetle, *Amblycerus martorelli* Bridwell, another **Horismenus** has been reared.

Horismenus apantelivorus Crawford, as determined by Mr. A. B. Gahan, has been found in a cage containing *Pluchea purpurascens* intercepted at Pt. Cangrejos, and also a new species of **Euderus.**

This, or another species of **Euderus** Mr. Francisco Seín found to be a minor parasite of the pepper flower-bud moth, *Gnorimoschema gudmanella* (Walsingham).

Of the "Two Undescribed Chalcid Parasites of the Woolly White Fly, *Aleurothrixus floccosus* (Maskell) from Haiti" (Proc. Ent. Soc. Washington, **34** (7): 118–122. Washington, D. C., October 1932) reared by Dr. H. L. Dozier, a single female "from the same host on lignum-vitae at Central Aguirre, P. R., June 28, 1925 is undoubtedly the same species but the general color is a shade deeper" and proves to be his **Euderomphale aleurothrixi.**

Eulophidae

From seed of the economically important forest tree "aceitillo" or satinwood (*Zanthoxylum flavum*), infested with its specific and normally very abundant enemy, the weevil *Apion martinezi* Marshall, a Eulophid wasp

has been reared which Mr. A. B. Gahan states to be a new species of **Emersonopsis.**

Diaulinus insularis, described by Mr. A. B. Gahan (Proc. U. S. National Museum, **48:** 165. Washington, D. C., December 16, 1914) from material reared by Dr. Richard T. Cotton from *Agromyza inaequalis* Malloch, has since been reared from *Agromyza pusilla* Meigen in "cohitre" (*Commelina longicaulis*) intercepted at Humacao.

Possibly the most interesting Eulophid now present in Puerto Rico is one originally described from Java, of which Mr. S. M. Dohanian, in his account of the "Life-History of the Thrips Parasite, **Dasyscapus parvipennis** Gahan, and the Technic for Breeding it," (Jour. Ec. Ent., **30** (1): 78–80, ref. 6. Menasha, February 1937) tells of its subsequent discovery on the Gold Coast of Africa, and of its importation and establishment in Trinidad, whence he made shipments to Puerto Rico. Because the cacao growers of Trinidad were primarily interested in natural means of control of their cacao thrips, *Selenopthrips rubrocinctus* (Giard), most observations have been made of parasitism on this host, but as Mr. Dohanian points out, "evidently it is not fastidious as regards hosts." Economically it is of little importance because it becomes sufficiently abundant to destroy many thrips only during wet weather, when thrips are least numerous, and the injury they then cause is negligible.

Spalangidae

Spalangia muscidarum Richardson, as identified by Mr. A. B. Gahan, was first reared from pupae of the horn fly, *Siphona irritans* (L.), in Puerto Rico by Mr. G. B. Merrill, at Guánica. This wasp never becomes sufficiently abundant to be more than a minor factor in control, altho in some cases as many as a third of the puparia are found parasitized.

Spalangia haematobiae Ashmead, a much less abundant horn fly parasite in Puerto Rico, was recorded by Dr. H. L. Dozier.

Spalangia drosophilae Ashmead, as determined by Mr. A. B. Gahan, was reared from horn fly puparia by Dr. Kenneth A. Bartlett, as is reported in his account of "The Introduction into Puerto Rico of Beneficial Insects to aid in the Control of the Horn Fly of Cattle" (Agr. Notes No. 88, pp. 6. Mayaguez, March 31, 1939).

Spalangia philippinensis Fullaway is an introduced parasite of horn fly puparia, brought from Hawaii, reared in captivity in Puerto Rico and, four months after release at Juana Díaz, recovered in the field by Dr. Bartlett (1939-5). "This parasite is not specific in its habits and is known to attack dipterous puparia in general. In the laboratory it was successfully reared on six species of Diptera, (but) by far the best results were obtained when puparia of the housefly and stablefly, *Musca domestica* and *Stomoxys*

calcitrans, were used". From Puerto Rico, material of this parasite (Anon. 1941-71) was sent to Colombia.

Pteromalidae

Muscidifurax raptor Girault & Sanders, as determined by Mr. A. B. Gahan, is another parasite of horn fly puparia that was found by Dr. K. A. Bartlett (1939-6) to be present in Puerto Rico.

Pachycrepoideus dubius Ashmead, as identified by Mr. C. F. W. Muesebeck, has also been reared in small numbers by Dr. Bartlett (1939-6) from horn fly puparia.

Neocatolaccus livii, described Mr. A. A. Girault (Insecutor Inscitiae Menstruus, **4**: 111. Washington, D. C., 1916) from type material reared by Mr. Thos. H. Jones, is a small Pteromalid parasitizing *Ctenodactylomyia watsoni* Felt, the Cecidomyid fly which makes galls in the leaves of sea-grape, *Coccoloba uwifera*.

Neocatolaccus filia is one of Mr. Girault's MS names for the wasps reared by Dr. Richard T. Cotton from the seeds of morning glory infested with puparia of *Agromyza caerulia* Malloch, and is similar to those from Agromyzid material present in the seeds of *Sida rhombifolia*.

Neocatolaccus sp. nov., as identified by Mr. A. B. Gahan, was reared from a puparium of the Syrphid fly *Baccha capitata* Loew on the branch of a "capá blanco" tree at San Sebastián by Dr. Luis F. Martorell.

Pachyneuron allograptae Ashmead is a blue-green Pteromalid wasp which has repeatedly been reared from Syrphid fly puparia, not only in Puerto Rico, but also on Mona Island, determinations having been made by Mr. A. B. Gahan. In every case, the parasites were 100% effective in control, so that the specific identity of the host is uncertain. Indeed, Mr. L. Courtney Fife (1939-9) found this parasite so abundant that "the control of *Aphis gossypii* effected by *Baccha clavata* was to a large extent annulled."

Pachyneuron eros Girault, as identified by Mr. C. F. W. Muesebeck, has been reared from mealybugs, most recently from *Phenacoccus gosspyii* Townsend & Cockerell, a serious mealybug pest at times on the ornamental *Acalypha wilkesiana*.

Pachyneuron siphonophorae Ashmead, as identified by Mr. C. F. W. Muesebeck, has repeatedly been reared from various species of aphids, first in Puerto Rico by Mr. Thos. H. Jones from *Aphis gossypii* Glover on okra, and reported by Dr. F. M. Wadley (1937-106) from *Sipha flava* Forbes and *Hysteroneura setariae* Thomas on sugar-cane.

Aplastomorpha calandrae (Howard) was noted, as a *Pteromalus*, by Mr. O. W. Barrett (1905-396) as "a common parasite of the rice weevil, *Calandra oryzae*," but the only subsequent record is of finding adults resting on cane leaves in a field at Salinas.

Zatropis deuterus Crawford, as identified by Mr. A. B. Gahan, was intercepted at Bayamón, resting on the leaves of a guava bush.

From the material of *Pluchea purpurascens* intercepted by Mr. A. S. Mills at Pt. Cangrejos, some small Pteromalid wasps emerged which Mr. A. B. Gahan doubtfully identifies as being a species of **Pteromalus.**

Elachertidae

At least three undescribed species of **Elachertus** occur in Puerto Rico. Possibly most abundant is that one, dark brown in color, with very conspicuous black eyes, which Dr. Luis F. Martorell reared from dead parasitized larvae of the "roble" and gourd Pyralid, *Eulepte concordalis* Hübner, at San Sebastián and at Yabucoa. Eight or ten greyish maggots emerged from each caterpillar, and by next day had transformed to naked, light brown pupae, from which adults emerged less than a week later. Another *Elachertus*, black in color, is a rather rare parasite on the Gracilariid leaf-miner, *Phyllonorycter* sp. nov., in potted insecticidal plants of *Tephrosia toxicaria* and *Tephrosia vogelii* at the Mayagüez Station, as noted in the Annual Report for 1939, p. 115. The third *Elachertus*, as identified by Mr. A. B. Gahan, is a brownish wasp which Mr. Francisco Seín reared in small numbers from coffee leaves infested with leaf-miners, *Leucoptera coffeella* (Guérin-Méneville).

A somewhat more slender yellowish-brown wasp with pink eyes and a dark spot on the distal half of the forewing, identified by Mr. A. B. Gahan as a new species of **Cirrospiloideus**, is an almost equally scarce parasite of the coffee leaf-miner in the mountains of Puerto Rico.

Besides these two less common parasites, Mr. O. W. Barrett (1906-22) reared what Dr. Ashmead identified as his *Zagrammosoma multilineata*, a "rare parasite, strictly primary." In Mr. Seín's rearings from Lares, Quebradillas and Isabela, wasps corresponding to this have been obtained which are quite different in details from Ashmead's species. Under the name **Zagrammosoma seini** Wolcott ("IB" 1936-525) they have been characterized as slender, "honey yellow wasps with median and dorsolateral black stripes on the thorax, the latter normally becoming broader on the abdomen, the other fainter and interrupted, but some specimens have the abdomen banded with black," the eyes salmon in color.

Dr. L. O. Howard described two continental species of **Euplectrus,** both of which have been identified from Puerto Rico: **comstocki** and **plathypenae**. The stout, black female wasp, about 2 mm. long, lays clusters of from five to thirty eggs on the back or side of a partly grown caterpillar. The maggots, which hatch in three days, remain clustered together in a heap on the outside of the caterpillar: a greenish-white mass which increases so rapidly in size that in a few days it has emptied the skin of its host, the

individual maggots then dispersing only to spin loose flimsy cocoons beneath. Numerous such parasitized caterpillars, which could not be identified, were found on the leaves of the yellow caltrop, *Tribulus cistoides*, at Puerta de Tierra in 1934, but other records of attack on *Laphygma frugiperda* (Abbot & Smith), *Leucania latiuscula* (H. S.), *Xylomiges sunia* Guenée, *Pseudoplusia oo* (Cramer) and *Gonitis praerupta* (Möschler), indicate how varied, among the Noctuidae, are its hosts. Caterpillars of the Hispaniolan sugar-cane butterfly, *Calisto pulchella* Lathy, have repeatedly been found dead from attack by an *Euplectrus*, but no comparable attack on any butterfly caterpillar has been observed in Puerto Rico. *Euplectrus* is really not common, but the clusters of cocoons under the dead caterpillar skin are so conspicuous, resting on top of a leaf in plain sight, that few observations of occurrence have failed of being recorded.

Pachyscapha insularis Howard, as identified by Mr. C. F. W. Muesebeck, has been reared from larvae of the bean leaf-webber, *Lamprosema indicata* (F .).

Grotiusomyia nigricans (Howard) is reported by Mr. A. B. Gahan (Ann. Ent. Soc. America, **25** (4): 736–757. Columbus, 1932) as another parasite of the larvae of the bean leaf-webber, *Lamprosema indicata* (F.), intercepted on lima beans.

Ardalus antillarum, a slender black wasp with legs and basal half of abdomen whitish, was described by Mr. A. B. Gahan (Proc. U. S. National Museum, **61** (2445): Art. 24, p. 20. Washington, D. C., 1922) "from larvae of *Prenes nero* Fabricius, May 10, 1921" collected at Caguas, Puerto Rico. Mr. Thos. H. Jones had reared this parasite from the same host, now called *Panoquina*, in 1913, and noted that "the larvae issue from the caterpillars and form naked black pupae nearby, sixteen individuals having been observed to come from one large larva."

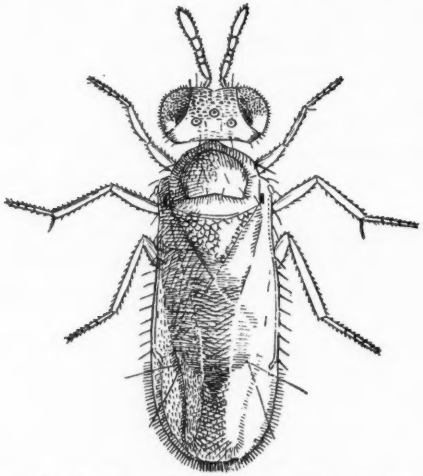
Elasmidae

Elasmus maculatus Howard, as determined by Mr. C. F. W. Muesebeck, has been reared from the cocoons of *Apanteles americanus* (Lepeletier) around the larvae of *Erinnyis ello* (L.) intercepted on yuca at Barceloneta

Aphelinidae

In most striking contrast to all the black, brown or iridescent purplish-bluish-green wasps is the pale, silvery green **Aphelinus (Aphytis) chrysomphali** Mercet, as determined by Mr. A. B. Gahan, most often to be seen on the underside of coconut palms infested with *Aspidiotus destructor* Signoret. It was first identified by Dr. L. O. Howard, as "apparently my *Aphelinus diaspidis*," but this most common Chalcid in the United States, Hawaii and Japan, described by Dr. E. O. Essing as "dull yellow through-

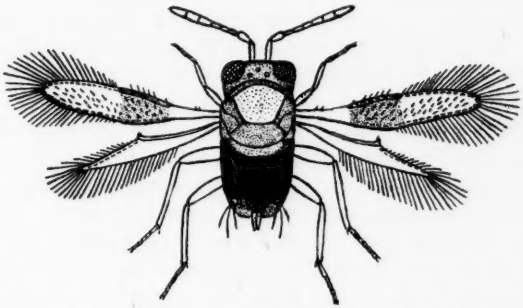
out," has not been found in Puerto Rico. By the circular holes in the back of so many scales, the extent of parasitism by this wasp in old scales may be estimated, and, of course, where many parasites have emerged from old scales, many of the younger ones may be presumed to be attacked, even if externally they give no indication. Until effective Coccinellid beetles were introduced into Puerto Rico, this wasp was the major, if ineffective, natural means of control of the coconut scale.



Aphelinus chrysomphali Mercet. Seventy times natural size. (Drawn by G. N. Wolcott.)

In one of the earliest attempts to ship beneficial insects from Puerto Rico, from parasitized scale insects on citrus branches collected at Mayagüez by Dr. C. W. Hooker and sent by him to California, the only parasite to emerge was **Aspidiotiphagus citrinus** Craw. Despite its original description from California material by Mr. Alex. Craw, this is a common endemic wasp in Puerto Rico, being also found in southern Europe, Brasil and the tropical Pacific Islands. Re-examining some of Craw's reared material, and comparing it with wasps reared in Puerto Rico from *Asterolecanium pustulans* (Cockerell), Dr. H. L. Dozier in his "Notes on Porto Rican Scale Parasites" (Jour. Dept. Agr. P. R., **10** (3 & 4): 267–277, fig. 11. San Juan, September 1927) prepared a new drawing of the wasp and pointed out such distinguishing characteristics as "head as wide as thorax", "the entire abdomen darkened", "the first joint of the club of the antennae almost as long as either of the apical two",

and "the submarginal vein always with two setae". The economic importance of this scale insect parasite is very considerable, altho rarely was it sufficiently abundant in commercial citrus groves so that spraying with oil emulsion was unnecessary. Two other parasites of *Asterolecanium pustulans* occur in Puerto Rico, and no studies have been made on their relative abundance, but, undisturbed by spraying or any other means of artificial control, they have been able to eliminate heavy infestations of pustule scale on "maga" (*Montezuma speciosissima*) and on the introduced *Sciacassia siamea* that threatened to kill the trees.



Aspidiotiphagus citrinus Craw. Greatly enlarged. (Drawn by H. L. Dozier.)

Aspidiotiphagus lounsburyi Berlese & Paoli, according to Dr. H. L. Dozier "readily distinguished from *Aspidiotiphagus citrinus* by its more yellowish color, the first joint of the club being only half the length of the second joint, and especially by having only a single seta on the submarginal vein", was reared by him from *Aspidiotus destructor* (Signoret) and from *Pseudaulacaspis pentagona* (Targioni). Mr. Thos. H. Jones had previously reared it from what at that time was called *Chionaspis citri* Comstock.

When the "Fish Hawk" brought Mr. Aug. Busck to Puerto Rico in 1899 with instructions to add to the record of the single scale insect known to exist there, he not only collected an abundance of scale insect material, but incidentally brought back to Washington some of their parasites.

Marietta busckii, described by Dr. L. O. Howard in his "New Genera and Species of Aphelininae" (U. S. Dept. Agr., Bur. Ent., Technical Series, **12** (4): 87. Washington, D. C., July 12, 1907) as a *Perrisopterus*, was "from *Asterolecanium aureum* Boisduval, collected at San Juan, P. R., February 21, 1899, by A. Busck". This wasp has subsequently been reared by Dr. H. L. Dozier from soft scale on citrus, from *Asterolecanium pustulans* (Cockerell) and from *Ceroplastes cirripediformis* Comstock.

Marietta pulchellus (Howard), as identified by Dr. H. L. Dozier, was reared from *Furcaspis biformis* (Cockerell) on maguey at Comerío. From material of *Saissetia nigra* (Nietner) recently sent to California, one of these wasps was reared.

Coccophagus scutellaris Dalman, reared by Dr. Stanley E. Flanders of California from material of *Saissetia nigra* (Nietner) from Puerto Rico, had previously been recorded under the name of *Coccophagus lunulatus* Howard by Dr. H. L. Dozier (1926-118) as being "an effective control of the soft brown scale, *Coccus hesperidum* L."

Aneristus ceroplastae Howard was identified by Dr. Stanley E. Flanders as one of the parasites reared from *Saissetia nigra* (Nietner) sent to California. This is possibly one of the most omnivorous of the scale insect parasites, and in "An Outbreak of the Red-Striped Sugar-Cane Scale" at Arecibo (Jour. Dept. Agr. P. R., **9** (4): 357–367, fig. 4. San Juan, October 1935), Dr. H. L. Dozier was able to prove "by dissecting the adult female scales that this was a primary parasite. In examining parasitized scales, some were found with as high as seven or eight emergence holes in them." Total parasitism, however, on *Pulvinaria iceryi* (Guérin-Méneville) in this outbreak was only 28.7 percent. Originally described from Jamaica, the wasp "is widely distributed in the tropics, occurring in Hawaii, Philippines, Java, India and the West Indies," and Dr. Dozier had reared it in Louisiana. In Puerto Rico he reared it from *Ceroplastes cirripediformis* Comstock, *Saissetia hemispherica* (Targioni) and *Eucalymnatus tessallatus* Signoret. Its "general color is black with slight purplish reflections, antennae dark brown with exception of the light colored scape." It "resembles greatly a *Coccophagus*, being distinguished . . . only by the shape and the structure of the posterior tibiae." The female averages 1.0 mm. in length, the males are somewhat smaller.

Pseudopteroptrix imitatrix Fullaway, originally described from Hawaii, is "an abundant parasite of *Howardia biclavis* (Comstock)" there, and in Puerto Rico has been reared from this host by Mr. Thos. H. Jones and Dr. H. L. Dozier, to which it is apparently restricted.

Prospaltella diaspidicola Silvestri, described from Italy as a parasite of *Pseudaulacaspis pentagona* (Targioni), has been reared from this host in South Africa, Japan and Brasil, and in small numbers by Dr. H. L. Dozier in Haiti and Puerto Rico. "Repeated rearing attempts in both Puerto Rico and Haiti failed to show the presence of *Prospaltella berlesei* Howard, and this useful parasite should be introduced." As suggested by Dr. Dozier, some of these parasites were eventually brought from Louisiana, as reported by Dr. K. A. Bartlett (Agr. Notes No. 85, Mayagüez, March 12, 1938), but apparently no attempt has been made to determine if this parasitic wasp became successfully established in Puerto Rico.

Prospaltella brunnea, described by Dr. L. O. Howard (Ann. Ent. Soc. America, **1:** 283. Columbus, 1908) from whitefly material collected by Mr. Aug. Busck at Bayamón in 1899, has not since been reared in Puerto Rico, but indicated that wasps of this genus are not confined to scale insects for hosts.

Prospaltella ciliata, described by A. B. Gahan (Proc. U. S. National Museum, **71** (2676) Art. 4: 1–39, pl. 1, fig. 3, ref. 8. Washington, D. C. 1927), is another whitefly parasite, having been reared from *Aleurodicus* sp. at San Juan, by Dr. H. L. Dozier, It resembles both *Prospaltella peltatus* Cockerell and *Encarsia portoricensis* Howard superficially, the "head and thorax mostly pale yellowish, the antennae and frons orange yellow," other parts of the wasp being mostly brownish black.

Encarsia basicincta Gahan (1927-20), of which the type was reared by Dr. H. L. Dozier from the woolly whitefly, *Aleurothrixus floccosus* (Maskell), is apparently quite a common parasite, for it has since been reared from its conspicuous but rarely abundant host. In general color this wasp is very pale yellow, almost white, marked with fuscuous; "antennae slightly dusky, legs entirely pale, all tarsi distinctly 5-jointed."

Encarsia portoricensis Howard (1907-77) was reared by Mr. Aug. Busck from whitefly material on a climbing vine at Bayamón, and wasps subsequently reared by Mr. R. H. Van Zwaluwenburg (P. R. 5022) at Mayagüez were identified as this species.

Encarsia nigricephala, reared by Dr. H. L. Dozier from whitefly material, *Bemisia* sp. on *Euphorbia hypericifolia* at Mayagüez, was described by him (1937-129) as being in general color pale yellowish "contrasting greatly with the black head, pronotum, and anterior discal two-thirds of praescutum."

Encarsia variegata (Howard), reared from whitefly material of *Paraleyrodes perseae* Quaintance on lemon foliage, occurs in Puerto Rico, having been identified by Dr. H. L. Dozier from his *Paraleyrodes naranjae* on citrus. It is characterized by an iridescent silvery white scutellum.

Encarsia vittata (Dozier) (1933–86) was described from material reared from a large whitefly, *Aleurodicus antillensis* Dozier, on "María" (*Calophyllum antillanum*) from Santurce, as an *Euderomphale.*

Eretmocerus portoricensis, the name given by Dr. H. L. Dozier to the local endemic species of wasp parasitizing most abundantly the woolly whitefly of citrus, *Aleurothrixus floccosus* (Maskell), formerly reported by him as *E. californicus* Howard, is characterized in his paper on "The Identity of certain Whitefly Parasites of the Genus *Eretmocerus* Hald., with Descriptions of New Species (Hymenoptera: Aphelininae)" (Proc. Ent. Soc. Washington, **34** (7): 112-118, fig. 1. Washington, D. C., October 1932) by the distinctive width and beaked shape of the antennal club.

Eretmocerus pallidus Dozier, as identified by Mr. A. B. Gahan, has been reared from the woody galls on the leaves of "corcho" (*Torrubia fragrans*) at Isabela.

Encyrtidae

The Encyrtid wasps have a large tibial spur on the middle pair of legs, which "enables them to execute great leaps, which they combine with flight" according to Dr. F. X. Williams (p. 254) in his "Handbook of the Insects and other Invertebrates of Hawaiian Sugar Cane Fields." Several Encyrtids from Hawaii which are parasitic on mealybugs have been introduced into Puerto Rico.

Pseudaphycus mundus is one of "Eight new Species of Chalcid-Flies of the Genus *Pseudaphycus* Clausen, with a Key to the Species" (Proc. U. S. National Museum, **96** (3200): 311-327. Washington, D. C., 1946) described by Mr. A. B. Gahan, which, under mistaken identity, was successfully introduced into Puerto Rico as a parasite of the mealybugs of sugar-cane. *Aphycus terryi* Fullaway, notes Dr. Williams, was "first found by Terry on Maui in 1909 and now (is) well distributed over the (Hawaiian) Islands." Mr. Gahan continues the story of how "living material of *A. terryi* was received in 1932 by T. E. Holloway, of the Bureau of Entomology and Plant Quarantine laboratory in New Orleans, from the Hawaiian Sugar Planters' Experiment Station in Hawaii. The original stock was apparently increased by propagation in the laboratory, "whence a shipment of parasitized grey mealybugs, *Trionymus boninsis* Kuwana, was sent to Puerto Rico on September 3, 1932." About a week after arrival, the parasites began to emerge and releases were made on the Station grounds. In making later examinations of mealybugs to determine if this introduction had been a success, a very similar parasite was reared from the pink mealybugs of sugar-cane. This proved to be, not the introduced parasite, but one hitherto unknown, determined by Mr. C. F. W. Muesebeck as *Pseudaphycus* sp. nov." (*in* Informe Anual Est. Exp. Insular P. R., 1932-3, pp. 92–103. San Juan, 1934), which Mr. Gahan eventually described under the name of *mundus*. He is of the opinion that "*Pseudaphycus mundus* may be indigenous in Louisiana, (for) it was reared at Audubon Park, New Orleans, as early as 1916, at least 16 years prior to the attempted introduction of *Aphycus terryi*. Circumstantial evidence would seem to indicate that in the attempt to increase the stock of the Hawaiian parasite in the laboratory, field collected material of the host which had already been attacked by *P. mundus* was introduced into the cage and the two species thus became confused."

Coccidoctonus trinidadensis Crawford, as recently determined by Mr. C. F. W. Muesebeck, was certainly the most abundant, and apparently the

only parasite of sugar-cane mealybugs in 1912, as is indicated by repeated rearings by Mr. Thos. H. Jones at that time. It has not since been found in Puerto Rico.

"**Pseudaphycus utilis** Timberlake, introduced by H. T. Osborn in 1912 from Vera Cruz, Mexico, (into Hawaii) completely changed the unsightly appearance of trees (infested with *Pseudococcus nipae* (Maskell), for almost immediately this mealybug was greatly reduced in numbers, so that now it is quite difficult to find a specimen of it. This wasp is yellowish to orange brown, compactly built, and including the wings, measures up to about 2 millimeters long" according to Dr. F. X. Williams (1931-255). In 1939, introductions into Puerto Rico of *Pseudaphycus utilis* were made by the Mayagüez Station, the wasp becoming established there and at Lajas, whence, according to the latest report by Dr. K. A. Bartlett (1943-19) it is "spreading rapidly."

The pineapple mealybug, *Pseudococcus brevipes* (Cockerell), apparently has no native parasites in Puerto Rico, and on the pan de azúcar and cabezona pineapples at Lajas is a very serious pest. Beginning in 1937, the Mayagüez Station began the importation of specific parasites of this mealybug: **Hambletonia pseudococcina** Compere, and **Anagyrus ananatis** Gahan (Proc. Hawaiian Ent. Soc., **13** (3): 357. Honolulu, March 1949), the type from Brasil, mistakenly recorded as Dr. Dozier's *A. coccidivorus* which he reared in Haiti from *Pseudococcus virgatus* (Cockerell). Importations were made from South America, and also via Hawaii, as is related by Dr. Kenneth A. Bartlett, telling of the "Introduction and Colonization of Two Parasites of the Pineapple Mealybug in Puerto Rico" (Jour. Agr. Univ. P. R. **23** (2): 67–72, ref. 2. Río Piedras, August 1939), and releases were made in all the principal pineapple producing regions of the Island. Subsequent search indicated that the introduced *Hambletonia* was well established and most effective in the control of the pineapple mealybug at Lajas.

Anagyrus similis is described by Dr. H. L. Dozier (1937-122) as very similar to his *A. coccidivorus*, but differs in having a "black head, pronotum, and prescutum." The type material was not reared, but swept from grass at Santa Isabel, Guánica and San Germán.

Anagyrus graminicolens was described by Dr. H. L. Dozier (1937-123) from an abundance of females swept from grass at Maní beach (Mayagüez) and from Guánica Lagoon. It may be "recognized by its long, prominently protruded, dark ovipositor, and very conspicuous black and white antennae," and "will undoubtedly prove to be a primary parasite of a grass-feeding mealybug."

Leptomastidea antillicola was described by Dr. H. L. Dozier (1937-121) from a single male reared by Dr. M. R. Smith from the mealybug *Pseu-*

dococcus virgatus (Cockerell) on the foliage of *Inga vera* at San Sebastián. It approximates 1.0 mm. in length, has green eyes and brown antennae, but the general color is yellowish, "the head and prescutum a soiled orange, the pronotum fuscous; the scutellum, mentanotum, propodeum and abdomen embrowned."

Leptomastix dactylopii was described by Dr. L. O. Howard from material reared from parasitized mealybugs in a greenhouse at Washington, D. C. He noted that one can "recognize infested scales by the fact that they lose almost entirely their wax or meal-like covering, and swell up into objects closely resembling dipterous puparia,... (a resemblance) which is heightened by the fact that the parasite in issuing cuts off a cap at the end of the scale insect, just as a dipterous insect forces off the end of its puparium." Dr. H. L. Dozier (1927-267) identified this wasp and redescribed it from material reared from *Pseudococcus citri* (Risso) at Río Piedras, as being "honey-yellow, with distinct reddish tinge on the mesonotum, the antennae and eyes blackish." It has previously been reared by Dr. Richard T. Cotton from mealybugs on cacao, and pupae from which this wasp emerged have been intercepted on guava fruits and on grapefruit at Palo Seco.

Achrysopophagus seini, "resembling a *Cheiloneurus* very closely" was described by Dr. H. L. Dozier (1927-269) from material which had been reared from mealybugs parasitized by *Leptomastix*, indicating that it "is most probably secondary, although absolute proof is lacking."

Achrysopophagus gahani was described by Dr. H. L. Dozier (1927-270) from a single female from parasitized mealybugs. Altho the material of this and *A. seini* actually reared was so scanty in amount, it may be presumed that if these wasps are in fact hyperparasites, they considerably reduce the effectiveness of *Leptomastix dactylopii* in the control of mealybugs.

Acerophagus nubilipennis, described by Dr. H. L. Dozier (1926-101) from two females, one from *Pseudococcus citri* (Risso), the other from *Pseudococcus adonidum* (L.), has not since been found. The general color of these wasps is "a very pale yellow, with the dorsum of a more pale orange tint, the abdomen pale with the hind margins of the two segments above the vibrissal plates brownish." The hyaline forewings have a conspicuous triangular smoky band across the disc.

Aphycus (Euaphycus) flavus Howard was the determination by Mr. P. H. Timberlake of the parasitic wasps reared by Dr. H. L. Dozier from *Pulvinaria iceryi* (Guérin-Méneville) at Arecibo. These wasps are orange-yellow above, but a paler yellow beneath, with pale yellow legs. This is the only record of *Aphycus flavus* from Puerto Rico, the wasps earlier reared from *Ceroplastes cirripediformis* Comstock by Mr. Thos. H. Jones having been identified by Mr. C. F. W. Muesebeck as a new species of **Aphycus, "near *eruptor* Howard."**

Plagiomerus cyanea (Ashmead), reared in Puerto Rico from *Ceroplastes cirripediformis* Comstock on lignum-vitae at Aguirre by Dr. H. L. Dozier, is redescribed and illustrated by him (1927-237), the genus being characterized by "the four-jointed funicle and the cluster of flattened scales at the apex of the scutellum".

Brethesiella sp. nov. is the determination by Mr. A. B. Gahan of one of the least abundant of the parasites of the wedding cake scale, *Icerya montserratensis* Riley & Howard.

Cheiloneurus pulvinariae, described by Dr. H. L. Dozier (1925-263) as a supposed parasite of *Aphycus flavus*, is fully as large as its supposed host It has subsequently been reared from the cottony cushion scale, *Icerya purchasi* Maskell, and from the wedding cake scale, *Icerya montserratensis* Riley & Howard.

Dr. Kenneth A. Bartlett reports (Anon. 1939-100) rearing an undetermined species of **Cheiloneurus** from *Asterolecanium bambusae* (Boisduval).

Procheiloneurus sp. nov., as identified by Mr. A. B. Gahan, has been intercepted on a scale on citron at Ponce.

Coccidoxenus portoricensis was described by Mr. J. C. Crawford (1913-249) from wasps reared by Mr. Thos. H. Jones from *Ceroplastes cistudiformis* T. & C. It has since been reared from a scale intercepted on gandul.

Mercetiella reticulata, described by Dr. H. L. Dozier as one of "Some New Porto Rican Scale Parasites (Hymenoptera: Encyrtidae)" (Proc. Ent. Soc. Washington, **28** (5): 97–102, fig. 4. Washington, D. C. May 1926), is a robust wasp with black head and thorax, the abdomen testaceous yellow. It is possibly the most important parasite of the pustule scale, *Asterolecanium pustulans* (Cockerell), which is at times one of the most serious pests of numerous economic trees in Puerto Rico. The endemic "maga" (*Montezuma speciosissima*), which produces a wood even more desirable than mahogany for cabinet making, when attacked by this scale has many of its secondary branches killed. After infestations by the pustule scale have developed for some time, however, no more fresh injury appears on the host tree, and a careful investigation of the old scales indicates that practically all have been parasitized.

Euaphycus portoricensis Dozier (1926-100) is a less abundant parasite of the pustule scale: a yellow wasp of which the eyes have a greenish bloom in life. Dr. Dozier considers this and his *Mercetiella reticulata* as being unquestionably primary parasites, and the principal factors in the control of this scale insect.

Encyrtus infelix Embleton is reported by Dr. M. R. Smith as a common parasite of the hemispherical scale, *Saissetia hemispherica* (Targioni), in coffee groves, in his paper on "The Relationship of Ants and other Organisms to certain Scale Insects on Coffee in Puerto Rico" (Jour. Agr.

Univ. P. R., **26** (2): 21–27. Río Piedras, April 1942). "The parasite most commonly seen attacking the hemispherical scale was *Encyrtus infelix*, which was noted in coffee groves, in nurseries and in experimental plots. This species is about 2.0 mm. long, of a dark brown color, and of the general form of the workers of the acrobatic ants (*Crematogaster* spp.), closely resembling the latter superficially. It was noted that the female wasp, while apparently preparing to oviposit, would often stroke the scale with her antennae, thus causing the scale to void honeydew. The ants exerted little if any effect in reducing parasitization of the hemispherical scale by *Encyrtus infelix*. The wasps were on the plant hour after hour, and day after day, parasitizing the scales as they chose, unmolested by the ants." Abundant as Dr. Smith found this wasp, it had never previously been reared, nor has it since been obtained from the hemispherical or any similar scale. An adult, as determined by Mr. C. F. W. Muesebeck, has, however, been intercepted on banana leaf at Guayama.

Ageniaspis sp., as determined by Mr. C. F. W. Muesebeck, has been intercepted resting on lima bean foliage at Loíza.

Comperia merceti var. **falsicornis** Gomez, as determined by Mr. A. B. Gahan, was intercepted on Bryophyllum leaf.

From sections of the base of sugar-cane stalks infested with the scale insect, *Targionia sacchari* (Cockerell), collected at Río Piedras by Mr. Thos. H. Jones, wasps were reared which many years later were identified by Mr. C. F. W. Muesebeck as a species of **Coccidencyrtus.**

Arrhenophagus chionaspidis Aurivillius, as determined by Dr. L. O. Howard and Mr. A. A. Girault from separate rearings by Mr. Thos. H. Jones of what was at the time called *Hemichionaspis minor* Maskell, at Río Piedras and at Ensenada, has not been noted since in Puerto Rico.

Pseudohomalopoda prima Girault, as identified by Dr. H. L. Dozier, was obtained by him from lemon foliage infested with Diaspine scales at Mayagüez.

Homalopoda cristata Howard, as identified by Dr. H. L. Dozier (1937-123), was obtained by sweeping grass and weeds at Guayama and Mayagüez. This concludes the list of Encyrtid wasps which are parasites, either primary or secondary, on mealybugs or scale insects. Numerous other species of Encyrtids occur in Puerto Rico, each with a specific host quite different from the immobile scale insects or mealybugs.

Carabunia myersi, described by Dr. James Waterston as "A New Encyrtid (Hym., Chalcid.) bred from *Clastoptera* (Hom. Cercop.)" (Bull. Ent. Research, **19** (3): 249-251, fig. 1. London, December 1928), was from froghopper material collected at Soledad, Cienfuegos, Cuba by Dr. J. G. Myers. Later, Dr. Myers found that this wasp attacked various Cercopids in both Cuba and Haiti, but the first record in Puerto Rico

was obtained by Mr. Francisco Seín at Lares. Non-parasitized nymphs of the coffee froghopper he found so scarce that no adult was reared, even from the largest and most nearly adult nymphs. Within a few days after collection, all nymphs began to darken and shortly thereafter the black wasp emerged, thus paralleling in Puerto Rico Dr. Myers' experience in Cuba. The wasp is "black or blackish brown with only the faintest submetallic reflections (very dark green) on the thoracic notum, length about 2.0 mm." It is obviously responsible for the normal scarcity of froghoppers on coffee in Puerto Rico, but does not attack those of sugar-cane and other grasses, which are such serious pests in Trinidad and neotropical South America.

Aphidencyrtus aphidivorus Mayr, as determined by C. F. W. Muesebeck, was reared from aphids of sugar-cane by Mr. Thos. H. Jones, and later reported more specifically by Dr. F. M. Wadley (1937-107) as being parasitic on *Hysteroneura setariae* Thomas.

Oöencyrtus prenidis, described by Mr. A. B. Gahan, "A New Encyrtid parasitic in the Eggs of Hesperiidae" (Jour. Agr. Univ. P. R., **27** (3): 137-9, Río Piedras, July 1943), was reared from *Panoquina* (= *Prenes*) spp. skipper butterfly eggs on the leaves of sugar-cane. The wasps are "0.75 mm. long, the head as broad as thorax, the abdomen much broader than long, subtriangular, as broad as thorax but much shorter," mostly black in color, with distinct metallic luster, the "legs, including coxae, yellowish testaceous." In observing "The Seasonal Cycle of Insect Abundance in Puerto Rican Cane Fields" (Jour. Agr. Univ. P. R., **27** (2): 85-104, fig. 12, ref. 16. Río Piedras, June 1944), it was noted that "from October to February, when eggs are most numerous, two-thirds or more of all eggs collected are black with parasitism, and all of the smaller number of eggs during the summer are parasitized. Not a single caterpillar, from April to September," was seen, their scarcity being largely due to parasitism of the eggs by these Encyrtid wasps.

Oöencyrtus sp. nov., as determined by Mr. A. B. Gahan, considerably reduces the effectiveness of "A Dryinid Parasite attacking *Baldulus maidis* (DeLong & Wolcott) in Puerto Rico" (Jour. Agr. Univ. P. R., **22** (4): 497. Río Piedras, February 1939) according to Dr. Kenneth A. Bartlett.

Isodromus sp. nov., as determined by Dr. H. L. Dozier, was found issuing from *Chrysopa* pupae by Mr. Francisco Seín, the larvae of which had been feeding on mealybugs on avocado.

Homalotylus terminalis (Say), as determined by Mr. C. F. W. Muesebeck, was first reported under this specific name from Puerto Rico by Dr. M. D. Leonard as "A Braconid Parasite on a Coccinellid New to Puerto Rico" (Jour. Ec. Ent., **26** (1): 294. Geneva, February 1933),

but neither the parasite nor the ladybeetle was new to Puerto Rico. Eighteen years previously, Mr. Thos. H. Jones in his paper on "Aphides or Plant-Lice attacking Sugar-Cane in Porto Rico" (Bull. No. 11, Board Comm. Agr. P. R., pp. 19, pl. 2. San Juan, 1915) had noted that "unfortunately both *Megilla innotata* Vauls. and *Cycloneda sanguinea* L. are parasitized by a small wasp, *Homalotylus obscurus* Howard." *H. obscurus* Howard is a synonym for *H. terminalis* (Say). "Ladybeetle larvae which are parasitized by this wasp, after becoming fully grown, attach themselves to some firm surface as do healthy larvae before pupating. Then, instead of the larval skin splitting and disclosing the ladybeetle pupa, the skin remains entire, turns black and shrinks, so that outlines can be seen of several small bodies: the pupae of the parasitic wasp. Through holes made in the larval skin, opposite these pupae, the adult winged parasites later issue. However, it appears that this parasite is itself parasitized by a smaller related insect, as yet undetermined, which we have bred from parasitized ladybird larvae." Mr. Jones' material has recently been re-determined by Mr. Muesebeck as being *Homalotylus terminalis* (Say). This wasp is a common continental species, 1.0 mm. long, "body somewhat piceous; head yellowish, antennae blackish," to quote from Mr. H. L. Viereck (1916-500): "The Hymenoptera of Connecticut."

Syrphophagus mesograptae Ashmead, as recently determined by Mr. C. F. W. Muesebeck, has been repeatedly reared from Syrphid fly puparia by Mr. Thos. H. Jones, and more recently intercepted from Syrphid fly puparia on corn at Palo Seco.

Habrolepoidea celia, described by Mr. A. A. Girault (Descriptiones Stellarum Novarum, pp. 22, 1920, privately published pamphlet) from material reared from Syrphid fly puparia of a species of *Ocyptamus* by Dr. Richard T. Cotton, at Río Piedras, has since been found at Pt. Cangrejos.

Copidosoma truncatellum Dalman, as determined by Mr. C. F. W. Muesebeck, has been reared from the looper larva of *Pseudoplusia oo* (Cramer), and also from a looper caterpillar on sugar-cane, presumably *Mocis repanda* (F.), hundreds of small wasps emerging from the dead caterpillar, or the cocoon which it had been able to spin before killed by wasp maggots within its body. Despite the large number of wasps from a single caterpillar, the species is not abundant generally, judging by the few rearing records.

Copidosoma sp. nov., as determined by Mr. A. B. Gahan was reared by Mr. Francisco Seín from the larvae of the pepper flower-bud moth, *Gnorimoschema gudmanella* (Walsingham). According to Mr. Seín, it is "the common and abundant parasite of the pepper flower-bud moth in all regions in Puerto Rico at all seasons of the year." When most in-

tensively engaged in rearing these caterpillars, he had a large vial full of these live iridescent metallic green wasps, but in searching for a place in which to release them, found other individuals abundant in every pepper field examined.

Paralitomastix sp. nov., as determined by Mr. A. B. Gahan, was found by Dr. M. D. Leonard and Mr. A. S. Mills (1931-472) parasitizing over half of the larvae of *Brachyacma palpigera* (Walsingham) in dry pigeon pea pods and in dry crotalaria pods at every point where examinations were made from Río Piedras to Cabo Rojo.

Hunterellus hookeri Howard has possibly more unusual habits than any other Encyrtid wasp, for these black wasps may often be seen running about in the hairs of dog, just emerged from, or attempting to parasitize nymphal ticks. The common tick on dogs in Puerto Rico is *Rhipicephalus sanguineus* Latreille, and its nymphs are unquestionably the normal host, but Mr. Thos. H. Jones reared these wasps from *Dermacentor nitens* Neumann. First observed in Texas by Dr. W. D. Hunter and Dr. W. A. Hooker, and named after them by Dr. L. O. Howard, this unique wasp has since been found to have a much more extensive distribution, and its occurrence in Puerto Rico has subsequently been observed by Dr. H. L. Dozier and Mr. H. D. Tate. The former noted (1937-128) "in every case the parasites issued from the second stage (nymphal) females" and that usually seven to ten wasps had developed in a single nymphal tick. Mr. Tate found (1941-20) that over 90 percent of the tick nymphs on individual dogs were sometimes parasitized at Mayagüez. Indeed, the wasps are often so numerous on tick-infested dogs as to be apparent to anyone, crawling about between the hairs on the parts of the dog's body where tick-infestation is greatest. Parasitized nymphs, from which the wasps have emerged, will sometimes be noted where the dog sleeps, of full size, but papery and with a small hole thru which the wasps emerged.

Thysanidae

The Thysanid wasps are scale insect parasites which have only six joints in their antennae, as compared with the Aphelinids, which have from five to nine; the Encyrtids, which have eleven; and the Pteromalids and Eupelmids, which have thirteen. In his "Monograph of the Signiphoridae" (Proc. U. S. National Museum, **45:** 189-233. Washington, D. C., 1913), Mr. A. A. Girault describes the first wasps of this family recorded from Puerto Rico, **Thysanus fax,** the type from San Juan, reared from *Chrysomphalus personatus* (Comstock). From the same host infesting "laurel de la India" (*Ficus nitida*) in the plaza at Río Piedras, Mr. Thos. H. Jones reared additional wasps, but none has since been found.

Thysanus flavus (Girault) was reared by Dr. H. L. Dozier (1927-272)

from lignum-vitae material infested with *Aleurothrixus floccosus* (Maskell), at Aguirre.

Thysanus nigrus (Ashmead) was reared by Dr. H. L. Dozier (1927-271) from *Pseudococcus citri* (Risso) at Río Piedras. This is a common continental species, "recorded," according to Dr. E. O. Essig (1926-843), "on *Aspidiotus perniciosus* Comst. in New York and on *Coccus hesperidum* Linn. in California, length 5.5 mm., wholly shining black, middle and front of tibiae brown, tarsi white, basal half of wings infuscated."

Thysanus bifasciatus (Ashmead), as determined by Mr. A. B. Gahan, was reared from *Pseudococcus citri* (Risso) material at Río Piedras by Mr. Francisco Seín, "most probably hyperparasitic on either *Leptomastix dactylopii* or *Achrysopophagus seini*" according to Dr. H. L. Dozier (1927-272). This wasp was originally described from St. Vincent, B. W. I.

Torymidae

Torymus montserrati Crawford, as identified by Mr. A. B. Gahan, was reared by Prof. James G. Needham from galls in the seed pods of the primrose willow, *Jussiaea angustifolia*, caused by "the larva of an obscure little Cecidomyiid midge, *Asphondylia rochae* Tavares."

Colyostichus biannulatus Mayr, as determined by Mr. C. F. W. Muesebeck, has been reared from fruits of *Piper* intercepted at Cidra by Mr. R. G. Oakley.

Colyostichus logicaudatus Mayr, according to Mr. A. B. Gahan, who identified the material intercepted on "jagüey" or wild fig trees (*Ficus laevigata*) at Arecibo, is a parasitic wasp, and not a carpifier.

Idarnes carmae Walker females have extremely long ovipositors, and sometimes occur in large numbers resting on the underside of leaves of wild fig trees, "jagüey" (*Ficus laevigata*), being so numerous as to form an item in the food of the lizards *Anolis stratulus* which inhabit the trunks of such trees. These wasps have repeatedly been intercepted at Arecibo, as determined by Mr. A. B. Gahan, who considers them probably parasitic, and have also been collected in the mountains between Cayey and Salinas.

Prof. J. A. Ramos collected on Mona Island a small wasp which Mr. A. B. Gahan identified as a species of **Megastigmus**.

Eurytomidae

Eurytoma ctenodactylomyii was described by Mr. A. A. Girault (Ins. Insc. Menstruus **4:** 111. Washington, D. C., 1916) from galls in seagrape (*Coccoloba uvifera*) made by the Cecidomyiid midge, *Ctenodactylomyia watsoni* Felt, the type material having been collected in Puerto Rico.

Systole geniculata Foerster, as determined by Mr. A. B. Gahan, was

collected from the flowers of coriander at the Isabela Seed Farm in April 1948 by Dr. Luis F. Martorell.

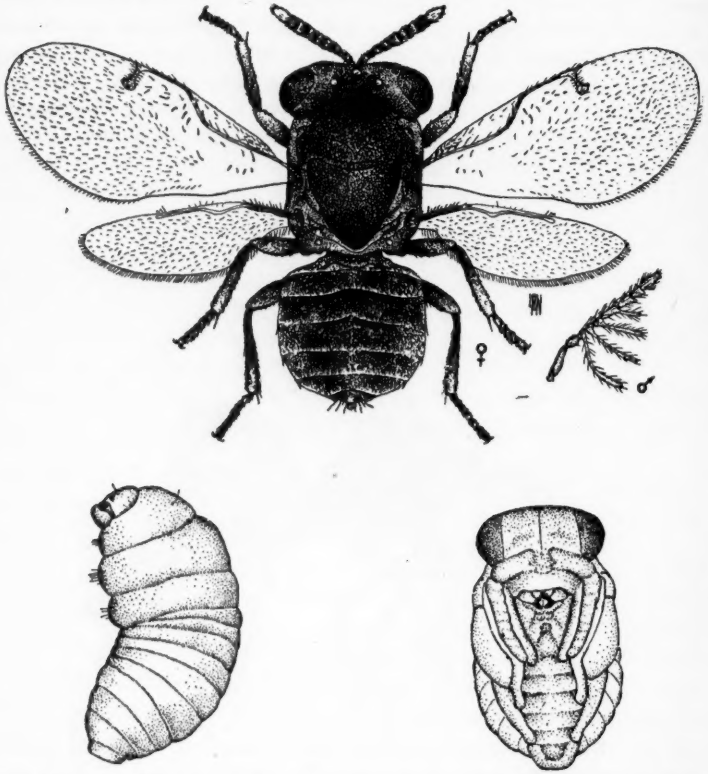
Rileya megastigma Ashmead is the name given by Mr. A. B. Gahan to some relatively large reddish wasps reared by Prof. James G. Needham from galls in the seed pods of the primrose willow, *Jussiaea angustifolia*, caused by the larvae of the Cecidomyiid midge, *Asphondylia rochae* Tavares.

Mr. José I. Otero noted that many of the hard little fruits of "escambrón" or "tintillo" (*Randia mitis*) which he collected at Aibonito had their seeds eaten by maggots. Reared to adult, these proved to be Eurytomid wasps which Mr. A. B. Gahan identified as a species of **Prodecatoma** previously found on the Island of Tortola, British Virgin Islands.

Female of *Bephrata cubensis* Ashmead, the Annona Seed Eurytomid, about one hundred times natural size. (Drawn by L. Pierre-Noël.)

Bephrata cubensis Ashmead, because of the injury which is caused by the exit of adults from infested seeds of Annonaceous fruits, is possibly the most conspicuous of all the Eurytomids. In leaving the seeds where development has taken place, each wasp excavates thru the green fruit a separate straight tunnel to the outside, the edges of which dry and permanently harden. It is possible that this is not an endemic insect, for the first record in Puerto Rico was in 1925, made by Dr. H. L. Dozier on this one of "Two Important West Indian Seed-Infesting Chalcid Wasps"

(Jour. Dept. Agr. P. R., **16** (2): 103–112, fig. 5, ref. 2. San Juan, July 1932): on "guanábana" (*Annona muricata*) at Río Piedras. The wasp is by no means common, the only subsequent records being of interception by Mr. C. G. Anderson from "corazón" (*Annona reticulata*) at Villalba in 1931, and from the same host at Yauco in 1937.



The Campeche Seed Eupelmid, *Tanaostigma haematoxyli* Dozier: female above, about fifty times natural size; antenna of male; fully-grown larva and pupa below. (Drawn by L. Pierre-Noël.)

Eupelmidae

The wasps, formerly considered Encyrtids, but according to Mr. A. B. Gahan at present classified in the tribe Tanaostigmini of the family Eupelmidae, which Dr. H. L. Dozier found so abundant in the seed pods of logwood or "campeche" (*Haematoxylon campechianum*) in Haiti, and which

he described, with illustrations of larva, pupa and adult drawn by Mr. L. Pierre-Noël, as **Tanaostigma haematoxyli,** he subsequently found breeding in the same host at Mayagüez.

Tanaostigmodes portoricensis, described by Mr. J. C. Crawford (1913-247), the type from Puerto Rico, is listed by Mr. R. H. Van Zwaluwenburg (P. R. 1623) as having been reared from the seed pods of the "guamá" (*Inga laurina*).

Zaischnopsis sp. is the determination by Mr. A. B. Gahan of an iridescent blue-green wasp which has twice been found in the mountains: resting on "cedro" (*Cedrela mexicana*) at Cayey and intercepted in an orange grove at Consumo, in the mountains back of Mayagüez.

The egg-masses of *Callimantis antillarum* Saussure, which are at times so abundant, glued to the needles of the beefwood trees around Camp Kofresí on Mona Island, are parasitized by small black wasps which Mr. A. B. Gahan identified as a new species of **Anastatus.** On p. 129 of his "Descriptions of some New Species of Chalcidoides from Cuba and Puerto Rico" (Memorias de la Sociedad Poey, Cubana Hist. Nat., Universidad de Habana, **8** (3): 125–134. Habana, 1934), Mr. Gahan includes that of **Anastatus viridicaput,** reared from Mantid eggs in Puerto Rico, collected Jan. 4, 1923. The wasps from Mona very definitely did not have green heads. Other wasps of this genus in nearby islands attack the eggs of various moths and bugs, but the known local species have been reared only from Mantid eggs.

Eupelmus allynii French, as determined by Mr. A. B. Gahan, was repeatedly intercepted at Pt. Cangrejos by Mr. A. S. Mills from *Pluchea purpurascens* material.

Eupelmus coccidivorus Gahan, as determined by Mr. C. F. W. Muesebeck, was reared in 1913 by Mr. Thos H. Jones from the scale insect, *Saissetia nigra* (Nietner), on cotton at Ensenada. Parasitized material of this scale sent to California (Anon. 1941-43) many years later was found to harbor an abundance of these parasites.

Eupelmus saissetiae Silvestri is considered by Dr. H. L. Dozier (1927-272) as an important factor in the natural control of the black scale, *Saissetia oleae* (Bernard), in Puerto Rico.

Prof. J. A. Ramos (1947-63) records collecting two species of **Eupelmus,** as determined by Mr. A. B. Gahan, from Mona Island.

Lecanobius cockerellii Ashmead, the first scale insect parasite to be reported from Puerto Rico (Ashmead 1900-341), having been reared from scale insect material collected by Mr. Aug. Busck, was repeatedly noted by Dr. H. L. Dozier (1926-119 & 1927-272) as being possibly the most important factor in the natural control of the black scale, *Saissetia oleae*

(Bernard). It was also found attacking the material of *Saissetia nigra* (Nietner) sent to California (Anon. 1941-43) for release in citrus groves there, but we have no report on whether it was able to become established in California.

Miscogasteridae

The little wasps reared by Dr. Richard T. Cotton from pupae of the bean leaf-miner, *Agromyza inaequalis* Malloch, at first determined by Mr. C. F. W. Muesebeck as *Cyrtogaster liqueata* Ashmead, which was subsequently found by Mr. A. B. Gahan to be a synonym for **Halticoptera senea** (Walker), have been repeatedly reared from flowers of the wild "margarita" (*Bidens pilosa*) intercepted at Dorado and Guayama. *Agromyza caerulia* Malloch and *Agromyza pusilla* Meigen were both reared from these small daisy flowers and are presumably the hosts of this parasitic wasp, having been intercepted at the same time. In Prof. James G. Needham's popular presentation of his observations on "An Insect Community Lives in Flower Heads" (National Geographic Magazine, **40** (3): 340–356, illus. Washington, D. C., September 1946) of *Bidens pilosa*, or shepherd's needles, in Florida, the presence of one Agromyzid is noted, but not of its parasite.

Lelaps spp. nov., as identified by Mr. A. B. Gahan, have repeatedly been intercepted: in an orange grove at Mayagüez, in a citrus grove at Arecibo, on pomarrosa at Bayamón.

Eucharidae

The larval stage of the Eucharid wasps is passed as a parasite on ants. **Kalapa furcata** F., as determined by Mr. A. B. Gahan, was collected as an adult, on a guava bush at San Sebastián by Dr. Luis F. Martorell.

Orasema smithi Howard was collected by Dr. Donald De Leon at Patillas as an adult resting on a "María" leaf. These wasps are of most extraordinary appearance. Illustrations of the male and female of *Kalapa floridana* are given on p. 413 of Dr. Wm. Morton Wheeler's book on "Ants," and on p. 414, of the male and female of *Orasema virdis*.

Perilampidae

Reared in Puerto Rico, but presumably not released, were a few specimens of hyperparasite identified by Mr. A. B. Gahan as a species of *Perilampus*, probably males of *Perilampus paraguayensis* Girault, obtained from the puparia of parasites of the cotton stainers of Perú. The primary Dipterous parasites were *Acaulona peruviana* Townsend and *Hyaloma chilensis* Macquart, as was reported by Dr. Kenneth A. Bartlett under the

heading of "Biological Control Activities" (*in* Mayagüez Station Report for 1942, pp. 15–17. Washington, D. C., 1943).

Perilampus hyalinus Say, as determined by Mr. A. B. Gahan, has been intercepted resting on flowers at Bayamón.

Another wasp determined by Mr. A. B. Gahan as a species of **Perilampidea**, reared from the puparium of the Syrphid fly, *Baccha clavata* F., at Lares, is so strikingly vari-colored and brightly iridescent as to have been described ("IP" 1923-60) under the name of **larium** Wolcott.

Chalcididae

Hind femora, so greatly enlarged for jumping as laterally to appear almost hemispherical, characterize the wasps of the genus *Brachymeria*. Slow-moving and quiet when undisturbed, the wasps are able to take flight with such unexpected rapidity when alarmed that they simply disappear. To be sure, Dr. Alex. Wetmore records finding one having been eaten by a martin, but it is doubtful if they often fall a prey to birds, and they move much too fast to be caught by a toad, or even by the most alert lizard.

From Cuba, Mr. E. T. Cresson (1865-101) described two species, as *Chalcis*, noting of *robusta* that it was "black, very robust; face golden-sericeous; tegulae and legs, except coxae and posterior femora within and a large black spot on the outside, bright yellow; wings nearly hyaline; abdomen subsessile, ovate and shining; length $2\frac{3}{4}$–$3\frac{1}{2}$ lines," and of his *incerta* that "the pubescence is more silvery instead of golden," and that the corresponding markings are yellowish-white that are golden in *robusta*. Characteristic *robusta* wasps do occur in Puerto Rico, but most of the local golden wasps are so much more extensively black as to have been described as *robustella* Wolcott ("IP" 1923-56). Arranged according to abundance in Puerto Rico, **Brachymeria incerta** (Cresson) is clearly first, **Brachymeria robustella** (Wolcott) second, with single records only of **Brachymeria robusta** (Cresson) and **Brachymeria ovata** (Say).

The first economic record, by Mr. O. A. Barrett (1906-23), under the name *Chalcis annulata* F., is of wasps reared from the pupae of the cotton leaf caterpillar, *Alabama argillacea* (Hübner). This is possibly one of the most common hosts, from which these Chalcid wasps have repeatedly been reared. In very extensive outbreaks of cotton caterpillar at Camuy and Boquerón in 1923, all pupae collected were found to be parasitized, and indeed the one species **Brachymeria incerta** may be considered as almost entirely responsible for checking these outbreaks. During some years, however, *Alabama* does not occur at all in Puerto Rico, and to maintain itself, the wasp must attack other pupae, of which Mr. R. H. Van Zwaluwenburg noted that of the "plumilla," *Megalopyge krugii* (Dewitz); the

citrus Hesperiid, *Eantis thraso* (Hübner) now called *Achylodes papinianus* Poey; the canna Hesperiid, *Calpodes ethlius* (Cramer), and the cabbage butterfly, *Pieris* (now called *Ascia*) *monuste* (L.).

Altho these wasps are presumed to attack only caterpillars, if their selected host has previously been parasitized, the wasp maggots may develop within the dipterous maggots and eventually emerge from their puparia. Tachinid (Larvaevorid) fly *Carcelia flavirostris* (Van der Wulp) puparia have been found parasitized in this way at Cidra, over half of them from a mummied wooly-bear caterpillar of *Ecpantheria icasia* (Cramer) eventually producing wasps of *Brachymeria incerta*, one wasp from each puparium.

Extensive outbreaks of caterpillars seem especially susceptible to attack, the almost fully-grown caterpillars being parasitized, and the adult wasp emerging from the chrysalis or pupa. An outbreak of the comparatively

Brachymeria incerta (Cresson), ten times natural size. (Drawn by F. Maximilien.)

rare Hypenid, *Sudariophera fastigiata* (H.S.), at Boquerón in 1923 was checked by these wasps, as was that of the sugar-cane looper caterpillar, *Mocis repanda* (F.), at Aguadilla in 1931, and of cabbage Pierids, *Ascia monuste* (L.), from Guánica to Guayanilla in June 1937.

From these comparatively large pupae or chrysalids, only a single medium-sized wasp emerges, leaving considerable of their contents unused and not needed for the development of the parasite. Variation in the size of the wasps developing in different hosts is possibly to be expected, for much smaller Pyralids may also serve as hosts: *Psara bipunctalis* (F.) on amaranthus; *Eulepte concordalis* Hübner on "roble" (*Tabebuia pallida*); and undetermined leaf-webbing species on "jagüey," on "capá blanco" and on "mangle botón." Very much smaller adult wasps have been reared from the Cosmopterygid coconut leaf-caterpillar, *Homaledra sabalella*

(Chambers), but except in size, identical with the large wasps from larger hosts. *Brachymeria incerta* occurs not only in Cuba, Hispaniola and in all parts of Puerto Rico, but has also been collected on Mona Island.

The type of **Brachymeria robustella** (Wolcott) was reared from cocoons of the "plumilla," *Megalopyge krugii* (Dewitz), but the species was earlier indicated (Jones & Wolcott 1922-49) as parasitizing the pupae of the sugar-cane looper, *Mocis repanda* (F.), and Mr. E. G. Smyth had noted a female ovipositing in a pupa on July 25th at 1:42 P.M., from which the resulting wasp emerged on August 6th at 4:00 P.M.

Dr. Gundlach lists *Chalcis incerta*, as determined by Cresson, and notes *Chalcis robusta* Cresson "de los contornos de Mayagüez." What we recognize as the latter species was reared from a pupa of *Mocis repanda* (F.) at Boquerón in 1923.

Brachymeria ovata (Say), as identified by Mr. C. F. W. Muesebeck, was reared from a pupa intercepted at Mayagüez by Mr. A. G. Harley. Several other wasps of this genus, unidentified as to species, have been collected in Puerto Rico. One of the smallest of these was reared by Mr. Francisco Seín from one of the unidentified caterpillars which he found eating into the base of a pineapple fruit from Cidra.

Haltichella sp. is the determination by Mr. A. B. Gahan of a wasp reared by Mr. Francisco Seín from the common caterpillar, *Batrachedra mathesoni* Busck, which feeds at the base of pineapple fruit. The single wasp reared was from material collected at Corozal, in April 1940.

Dr. Gundlach lists as a *Smiera*, **Spilochalcis emarginata** (F.) as "rara," and Drs. Dewitz and Ashmead quote his record. It has not since been found in Puerto Rico.

Spilochalcis eubule, described by Mr. E. T. Cresson (1865-93) as *Smiera Eubule* Poey, MSS, and noted by him as destroying "the larva of *Callidryas Eubule*," is 4 lines long and luteous-yellow in color. The dull ferrugineous markings described by Mr. Cresson on the Cuban specimens are very dark brown on Puerto Rican individuals, and the vertex of the head is definitely black. Rearings have been made at Guánica and Río Piedras in Puerto Rico from the same host noted by Mr. Cresson, and also at Río Piedras from chrysalids of *Phoebis statira cubana* d'Almeida, of which the caterpillars feed on the tender leaves of "quenepa" (*Melicocca bijuga*). Adult wasps have been collected at Salinas, Guánica, Aibonito and Arecibo, as well as in Cuba and Hispaniola.

Spilochalcis flavopicta (Cresson), as identified by Mr. A. B. Gahan, was found among the dead or dying insects resting on the window-sills of the cotton ginnery at Isabela in September 1945, after its interior had been sprayed with 5 percent DDT dissolved in kerosene. Mr. E. Courtney Fife (1937-7) has recorded it as a parasite of *Pyroderces rileyi* (Walsingham),

dead adults of which moth were almost as abundant as PBW moths in the ginnery. Dr. Gundlach considered it "común" when he was collecting here, and Drs. Dewitz and Ashmead list it as a *Smiera*. Mr. E. T. Cresson (1865-99), describing it from Cuba as a *Smiera*, characterizes it as "black, varied with pale yellowish spots and marks; wings subhyaline; abdomen elongate, acuminate and pointed at tip; hind femora armed beneath with a row of numerous small teeth; length $1\frac{3}{4}$–3 lines." On Mona Island, Dr. Luis F. Martorell collected on weeds near Camp Kofresí a single specimen which Mr. A. B. Gahan identified as a species of *Spilochalcis* "very near to *flavopicta* Cresson, possibly only a variant."

Spilochalcis femorata (F.), according to Dr. B. D. Burks, in his "Revision of the Chalcid-Flies of the Tribe Chalcidini in America North of Mexico" (Proc. U. S. National Museum, **88** (3082): 237–354, fig. 9. Washington, D. C., 1940), "is perhaps the commonest species of this group in the West Indies and Central America, particularly in cultivated areas." In synonymy with it, Dr. Burks lists the records by Drs. Dewitz, Ashmead and Gundlach of the occurrence of *Smiera ignea* Cresson in Puerto Rico, as well as that of *Smiera punctata* F., concerning which Dr. Gundlach notes "las larvas de todas las especies de esta familia se crían dentro del cuerpo de orugas y larvas, o crysálidas y ninfas." Subsequently correctly listed by Mr. R. H. Van Zwaluwenburg (P. R. 49), it is presumably this species which Dr. Alex. Wetmore found to have been eaten by the ani. The lizards, *Anolis pulchellus* and *cristatellus*, are able to catch this wasp, altho not in large numbers. Repeatedly collected from various kinds of vegetation in all parts of the Island, it has been reared only once, by Mr. E. G. Smyth at Río Piedras, from *Psara bipunctalis* (F.), a Pyralid feeding on the leaves of the weed amaranthus. Mr. Charles E. Wilson, studying the "Truck-Crop Insect Pests in the Virgin Islands (Bulletin No. 4, Virgin Islands Agr. Expt. Station, pp. 35, fig. 24. Washington, D. C., 1923) records rearing this species, and also *Spilochalcis vittata* (Ashmead): a synonym for *igneoides* (Kirby), not known to date from Puerto Rico, from *Laphygma frugiperda* (Abbot & Smith), and from *Heliothis obsoleta* (F.). "This common tropical and subtropical species" to quote further from Dr. Burks, "yellow, orange or red with variable black markings, 5.5 to 8.0 mm. long, is most easily recognized by its very large compound eyes, the long and slender antennal flagellum with the three apical segments conspicuously shorter than the basal ones, the wide and deep scrobe cavity, and the usually large and acute basal tooth of the metafemur."

From coconut palm fronds infested with caterpillars of the Cosmopterygid moth, *Homaledra sabalella* (Chambers), not only were exceptionally minute adults of *Brachymeria incerta* (Cresson) reared, as already noted, but two other equally small wasps were also found. These were described ("IP"

1923-58) under the names of **Spilochalcis cocois** Wolcott for the one mostly yellowish-green in color, and **Spilochalcis homaledrae** Wolcott for the one mostly black. The former has subsequently been intercepted in a fruitfly trap at Bayamón; the latter was collected by Dr. Luis F. Martorell on the blossoms of "corcho" (*Pisonia albida*) on Mona Island, both determinations having been made by Mr. A. B. Gahan.

Spilochalcis hirtifemora (Ashmead) is the correct name, according to Dr. Burks (1940-295) for the small, yellowish-ferrugineous wasps reared from the puparia of Syrphid flies, *Toxomerus polygonastyla* Metcalf MS, collected on tobacco at Caguas and described ("IP" 1923-57) as *Spilochalcis syrphidis* Wolcott. This species occurs not only in Puerto Rico, but also in Hispaniola, Cuba and generally in the southern United States, having been reared not only from other Syrphid fly puparia, but also from *Apanteles* wasps.

Spilochalcis sp. nov. is the identification by Mr. A. B. Gahan of some minute wasps reared from the fish-scale-like cocoons, presumed to be of Dryinids parasitic on Fulgorid nymphs of *Ormenis* spp., found on both sides of grapefruit leaves at Manatí. In addition to these minute Chalcids, another parasite associated with this material may be a Lestrodyinini of the subfamily Anteoninae.

Ceratosmicra debilis (Say) has been identified by Mr. A. B. Gahan as the wasp reared by Mr. Thos. H. Jones from the pupa of *Oxyptilus* sp. on "sacatrapo" (*Caperonia palustris*), another specimen of which Prof. J. A. Ramos collected on Mona Island. It is a pale yellow wasp, with variable markings of tan, brown and black, the females 4.5 to 5.0 mm. long, the males averaging 1.0 mm. smaller.

Euchrysia buscki Ashmead, as identified by Mr. A. B. Gahan, was collected by Dr. Donald De Leon at Guánica resting on a mahogany tree.

Dirhinus giffardi Silvestri, a pupal parasite of the Mediterranean fruitfly, *Ceratitis capitata* (Wiedemann), originally from Nigeria in Africa but subsubsequently introduced into Hawaii, was received in Puerto Rico from Hawaii (Mayagüez Station Report for 1937, p. 95) and the wasps reared in the laboratory on housefly puparia. In succeeding years, liberations have been made at numerous points on the Island, but there is no record of recovery in the field from local fruitfly puparia.

Mr. A. B. Gahan has recently identified as a new species of *Trigonura* some large wasps collected at Indiera in the mountains between Lares, Maricao and Yauco on September 8th, 1921, which were apparently attempting to oviposit in the eggs or small larvae of the Cerambycid beetle, *Neoclytus araeniformis* Olivier, under the bark of logs of *Inga vera*. As compared with *Trigonura californica* Rohwer, which, according to Dr. E. O. Essig (1926-851), has been reared from the larvae of *Chrysobothris mali* Horn at Placerville, California, the local species, which I have named

Trigonuria puertoricensis n. sp., is larger, being 9.0 mm. long, and is entirely black except for chestnut femora, basal segments of fore and mid tarsi, and dark brown eyes. The propodeum is most coarsely and deeply shagreened, the remainder of the thorax unevenly and less shagreened, unevenly pubescent; the elongate, shining black or very dark red abdomen as long as the rest of the body; its basal and very pointed terminal segments each approximately one-third its total length, the intermediate four pubescent segments together not quite as long. The greatly dilated posterior femora is highly polished (as is also the sharply delimited region opposite the basal abdominal segment), darker at base, somewhat laterally and on the ventral margin, with one large and ten much smaller teeth. Eighteen females were collected originally, of which ten should be in the U. S. National Museum, and another was since found by Mr. Francisco Seín at Lares in December 1922, also on a log of *Inga vera*.

PROCTOTRUPOIDEA: Calliceratidae

Calliceras sp. and **Aphanogmus** sp. nov. were the determinations made by Mr. C. F. W. Muesebeck of the wasps which Mr. A. S. Mills obtained from *Pluchea purpurascens* material intercepted at Pt. Cangrejos.

Diapriidae

Ashmeadopria sp. nov., as determined by Mr. C. F. Muesebeck, is responsible for "a parasitism of ten percent of hornfly puparia" according to Dr. Kenneth A. Bartlett (1939-6). This wasp was subsequently reared from puparia of *Anastrepha mombinpraeoptans* Seín, the common jobo fruitfly.

Scelionidae

Phanurus flavus, described by Mr. Alan P. Dodd as "A New Proctotrypoid Egg-Parasite from the West Indies (Hym.)" (Entomological News, **25** (8): 350. Philadelphia, October 1914), was reared by Mr. Thos. H. Jones in April 1912, from the eggs of a Fulgorid, *Ormenis*, on the twigs of a shrub of *Cordia*. The females, 0.8 mm. long, are golden yellow, the eyes and ocelli black, and have 11-jointed antennae, while the males have 12 jointed, filiform antennae. This is a very common parasite on the eggs of the various species of *Ormenis*, and when an outbreak of these Fulgorids has developed, one will often find all egg-clusters parasitized.

Prophanurus alecto Crawford is a black Scelionid wasp which parasitizes the egg-clusters of the sugar-cane moth stalk-borer, *Diatraea saccharalis* (F.). The presence of a developing light yellow wasp of *Trichogramma minutum* Riley within the egg of the moth-borer causes the egg to turn black within less than 48 hours, and so also does the presence of the de-

veloping black wasp of *Prophanurus alecto*. Indeed, the latter is merely a nuisance to the entomologist attempting to make exact field observations on *Trichogramma*. In Puerto Rico at least, its incidence is so uncertain, its presence normally so rare, yet when noted at all, it occurs in such large numbers as to quite overshadow the more or less predictable variations in the abundance of *Trichogramma*, the much more common and economically important parasite. "*Prophanurus alecto* Crawford in Puerto Rico" (Jour. Ec. Ent., **32** (1): 152–3. Menasha, February 1939) was "first reared from the eggs of *Diatraea saccharalis* F. at Río Piedras and Toa Baja in 1921, and not found again on the Island until 1938. In October of that year it was the only parasite attacking egg-clusters of *Diatraea* at Isabela

Prophanurus alecto Crawford, eighty-five times natural size. (Drawn by G. N. Wolcott.)

(determination confirmed by Mr. C. F. W. Muesebeck) and mingled with *Trichogramma* at Quebradillas and Coloso. A month later it had disappeared from the Isabela region, but was responsible for seventy or eighty per cent parasitism of *Diatraea* eggs at Guánica (and thoroly disorganizing the *Trichogramma* release experiment there), where it had never before been collected. By the next month it was gone at Guánica, but had appeared at Patillas and Arroyo, where it had disappeared by the next observation. It was very abundant at Las Piedras in April 1939, and noted at Isabela, and again in December at Quebradillas, but has not since been recorded from anywhere in Puerto Rico."

Hoploteleia sp. nov., as identified by Mr. C. F. W. Muesebeck, was collected by Prof. J. A. Ramos (1947–64) on Mona Island, and has been intercepted on leaves of "almendro" at Bayamón.

Telenomus sphingis Ashmead is considered by Mr. A. B. Gahan (Proc.

U. S. National Museum, **77** (2831) Art. 8: 1–12. Washington, D. C., 1930) to be the correct name for the wasp parasitic on the eggs of the tobacco hornworm, *Phlegethontius sexta jamaicensis* Butler, noted by Mr. W. V. Tower in his reports as Entomologist at the Mayagüez Station in 1907 and 1909 as *Telenomus monilicornis* Ashmead, identification having been made by Mr. J. C. Crawford. Under the latter name, this wasp was described from the island of St. Vincent, but the type of *T. sphingis* Ashmead was reared from tobacco hornworm eggs at Jacksonville, Florida, and others have been reared from this host at Clarksville, Tenn., and from the Dominican Republic. It has not been reported from Cuba or Jamaica, and normally is not sufficiently abundant in Puerto Rico to be of much value in the natural control of the tobacco hornworm.

One of the rarer parasites reared by Mr. Francisco Seín from coffee leafminer material was determined by Mr. A. B. Gahan as being another species of **Telenomus**, "near *convergens* Ashmead."

Other species of **Telenomus,** as identified by Mr. A. G. Gahan, have been reared from the round woody galls on the leaves of "corcho" (*Torrubia fragrans*) at Isabela, and from the fleshy galls of *Ctenodactylomyia watsoni* Felt on the leaves of seagrape (*Coccoloba uvifera*) at Quebradillas.

Telenomus flaviventris Ashmead, and a new species of **Telenomus,** as determined by Mr. C. F. W. Muesebeck, were reared by Mr. Thos. H. Jones from the eggs of the Fulgorid planthopper, *Ormenis* sp., collected on the leaves of sugar-cane.

Hadronotus carinatifrons Ashmead, as identified by Mr. C. F. W. Muesebeck was reared by Mr. Thos H. Jones in May 1912 at Canóvanas from what he thought might be Coreid eggs.

Platygastridae

From galls on the leaves of trees of *Torrubia fragrans* (DumCours) Standley at Yabucoa, Dr. Luis F. Martorell reared numerous small black wasps, somewhat more than 1.0 mm. long, with brown legs and antennae, which Mr. C. F. W. Muesebeck identified as a species of **Isostasius**. As the other species of this genus are parasites of the larvae of gall-making Cecidomyiids, it is quite possible that wasps reared were hyperparasites on the insect actually responsible for the hypertrophy of the corcho leaves.

Leptacis sp. nov. was the determination by C. F. W. Muesebeck of a wasp intercepted at San Juan resting on a canna leaf.

Formicidae: ANTS: Cerapachyinae

Accompanying Dr. N. L. Britton, Director of the New York Botanical Garden, in March 1906 to Puerto Rico and Culebra, was that already eminent specialist in ants: Dr. Wm. Morton Wheeler. His paper on "The Ants

of Porto Rico and the Virgin Islands" (Bulletin American Museum of Natural History, **24** (6): 117–158, pl. 2. New York, February 7, 1908) remained the final authority for twenty-eight years. From July 1935 to June 1936, Dr. M. R. Smith was resident at Mayagüez, primarily observing ants in the coffee groves or in pineapple fields as they affected aphids, mealybugs and scale insects, but also collecting in the Maricao Forest and elsewhere. His observations were summarized in "The Ants of Puerto Rico" (Jour. Agr. Univ. P. R., **20** (4): 819–875, fig. 19, ref. 16. San Juan, October 1936). As it happened, however, neither of these specialists in ants found the rarest and most unique species occurring on the Island.

Cerapachys (Syscia) seini, described by Dr. Wm. Mann (Jour. Washington Acad. Sci., **21** (17): 440–1, fig. 1. Washington, D. C., October 19, 1931), was found by Mr. Francisco Seín, while conducting researches on "The Sugar Cane Root Caterpillar, *Perforadix sacchari*, new Genus and Species, and other new Root Pests in Puerto Rico" (Jour. Dept. Agr. P. R., **16** (3): 167–191, pl. 10. San Juan, August 1930): the sole representative in Puerto Rico of the subfamily Cerapachyinae. Dr. Mann thinks "it very probable that it is endemic to New Guinea and has been introduced into Puerto Rico in soil with sugar cane;" a suggestion which seems highly improbable considering that all the new varieties of sugar-cane brought to Puerto Rico were as cuttings from the Plant Quarantine greenhouse in Washington. Mr. Seín writes that "while digging in a moist clay loam, a nest of these ants was found in which an immobile and probably dead full-grown caterpillar of *Perforadix sacchari* was lying on its side, partly coiled, while several of the larvae of the ant were hanging from its sides with their mouth parts attached to its epidermis. Ant larvae are usually fed by the workers and this habit of directly feeding upon a caterpillar is extraordinary. We have been able to witness it on one occasion only. *Cerapachys* belongs to a group of primitive subterranean ants. The condition in which the ant larvae feed directly upon the dead or paralyzed caterpillars is apparently more primitive than the feeding of the larvae by the adult ants with regurgitated food." Dr. Smith did not find *Cerapachys seini* during his stay in Puerto Rico, and apparently the original record is the only one of its occurrence either here or elsewhere.

Ponerinae

Platythyrea punctata (F. Smith) is widely distributed in neotropical regions, the type being from the Dominican Republic. Dr. Wheeler found workers "running on the ground in a shady cafetal," and they have since been noted in a termite nest at Ciales. Dr. M. R. Smith states that the large black workers, so densely coated with pubescence as to appear pruinose or metallic, are predaceous, foraging singly on the ground or on the trunks

of trees. The nests are in shady coffee groves or forest, in stumps or logs, in colonies of only a few hundred individuals. Prof. J. A. Ramos noted (1947–64) a single worker on Mona Island. Collections from Puerto Rico are from the western end of the Island, none having been made on El Yunque or elsewhere in the Luquillo Mountains.

Euponera (Trachymesopus) stigma (F.), found by Dr. Wheeler "in Culebra nesting in a rotten cactus stump," and at Utuado in "small colonies under stones and logs," has been intercepted by Mr. R. G. Oakley on orange leaves in the mountains back of Ponce, and by Dr. Smith at Mayagüez and in the Maricao Forest at an elevation of 3,500 feet. The predaceous workers, slow of movement, are rarely seen foraging in the open, but the winged adults are very active.

Ponera ergatandria Forel, found by Dr. Wheeler only at Utuado "under prostrate plantain stems," is noted by Dr. Smith as "capable of living in both very arid and moist habitats," collections by Dr. H. L. Dozier at Guayama, Sabana Grande and Lajas having been made from under dry cow dung, and by Dr. Smith at Ensenada and Mayagüez.

Ponera opaciceps Mayr is possibly the commonest species of the genus in Puerto Rico, Dr. Wheeler having made repeated collections in the coffee groves around Utuado and in the mountains to the south, "under stones or under the bark of decaying logs in damp places." He also found it on Culebra, and Prof. J. A. Ramos (1947–64) recently made collections on Mona Island. Dr. Alex. Wetmore reports it as an item in the food of the swallow, and three individuals were noted in three square feet of pasture examined at Pt. Cangrejos. Dr. H. L. Dozier collected it under cow dung in the xerophytic regions of Puerto Rico, some of his collections being considered of the variety **jamaicensis** Aguayo by Dr. M. R. Smith, who notes distinguishing characters.

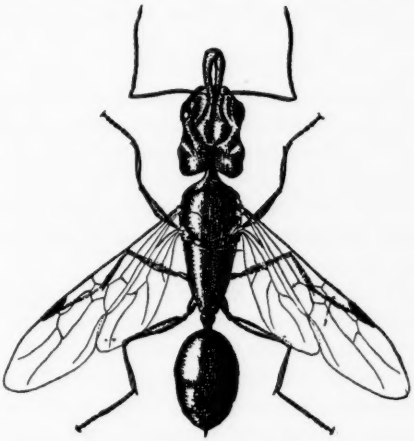
Ponera trigona var. **opacior** Forel is reported by Dr. M. R. Smith as having been collected in the mountains 14 Km. east of Mayagüez.

Anochetus mayri Emery was found by Dr. Wheeler wherever he looked, from El Morro at San Juan to Monte Morales and Monte Mandios, in small colonies of often only a dozen individuals "common under dead leaves and stones in shade of the cafetals and platanals." Dr. Smith also collected these ants from the coast at Arecibo and Mayagüez to the higher elevations in the Maricao Forest. He notes that "the workers, which are slow of movement, forage singly." They are eaten both by the grass lizard, *Anolis pulchellus*, and by the large, dark, crested lizard, *Anolis cristatellus*, in appreciable numbers.

Anochetus (Stenomyrmex) emarginatus testaceus Forel, noted by Dr. Wheeler only on Culebra Island, in the dry arroyos of Mount Resaca, occurs in colonies of thirty to one hundred individuals nesting under

stones in the shade of trees. It does occur in Puerto Rico, however, as Dr. Wm. Mann identified individuals intercepted in a grapefruit grove at Palo Seco.

"Berraco" is the common name in Puerto Rico for the fiercely biting, large black ant known as **Odontomachus haematoda** (L.) or its reddish brown and slightly smaller subspecies **insularis** Guérin-Méneville, variety **ruginodis** Wheeler, of which winged adults often come to light. According to Dr. Wheeler, "this variety, which is less common than the typical form of the species, was found only in open, sunny places in the sandy soil of river bottoms. It is smaller than the typical *haematoda*, has a paler head, and



The "Berraco," *Odontomachus haematoda* (L.), winged adult, five times natural size. (Drawn by F. Maximilien.)

the petiole is less acuminate above, with a shorter spine." Specimens identified by him as this variety were collected at Río Piedras by Mr. Thos. H. Jones under leaf-sheaths of sugar-cane, associated with mealybugs, and Mr. D. L. Van Dine found it in abundance around the roots of sugar-cane at Guánica. It has also been found on Vieques Island on the roots of sugar-cane. Prof. J. A. Ramos (1947–64) found a nest of the subspecies *insularis*, as identified by Dr. M. R. Smith, in a rotten stump of "papayo" (*Metopium toxiferum*) on Mona Island, and earlier collections by Dr. Luis F. Martorell on Mona have been identified as the typical form from a nest in a rotten stump, and adults at light at Sardinera Beach. These ants form an appreciable item in the food of three species of lizards, and Dr. Alex. Wetmore found them eaten by the petchary and the mocking-

bird. Living in part of a comején termite nest at Ciales, together with large Scarabaeid beetles, *Phileurus didymus* L., these aggressive ants occupied a considerable part of the nest in which live termites were their unwilling co-tennants. More usually, according to Dr. Smith, they live in well-rotted wood of logs and stumps, in nests of several hundred individuals, and he noted that "the workers can leap several inches by closing their widely opened mandibles suddenly, thus making a clicking sound."

As an "Addition to the Ant Fauna of the West Indies and Central America" (Bull. Amer. Museum Nat. Hist., **42** (8): 404. New York, 1920), Dr. Wm. Mann described from material collected by Dr. Wheeler at Monte Mandios, the variety **notata** of **Odontomachus haematoda,** as large as the typical form, but parts of the body being reddish-brown instead of black.

Pseudomyrminae

Pseudomyrma flavidula F. Smith was represented in Dr. Wheeler's collections from Puerto Rico by but a single worker at Tallaboa, but Dr. M. R. Smith found it at Las Marías and at Mayagüez attending the green and hemispherical scales on coffee trees, and Dr. H. L. Dozier at Lajas. "The worker can be recognized by its narrow, elongate body, exceedingly large eyes, general yellow color and on the gaster the presence of a pair of prominent black spots near the base."

Pseudomyrma flavidula var. **delicatula** Forel was the identification by Dr. Wm. Morton Wheeler of the little yellow biting ants which Mr. Thos. H. Jones found running over the badly rotted trunk of a tree near a cane field at Río Piedras, and also on the leaves of the adjacent cane plants. By comparison with these specimens, Mr. John D. More identified others found on cotton at Pt. Cangrejos, on a coffee tree at San Germán, and associated with *Platythyrea punctata* F. Smith in an old comején termite nest at Ciales. It has since been intercepted in grapefruit groves at Arecibo, Manatí and Bayamón, this variety apparently being reasonably common along the north coast.

Myrmicinae

Monomorium carbonarium (F. Smith), subsp. **ebeninum** Forel is one of the most common ants of the West Indies, and is possibly more abundant now than when Dr. Wheeler made his collections: on Culebra Island, and in Puerto Rico at Santurce, Vega Baja, Arecibo, Utuado, Adjuntas, Coamo Springs and Aibonito. He found this little black ant "common under stones, in Tillandsias and under bark," but otherwise gave it no exceptional notice. Entomologists working in cane fields first found it nesting under the leaf-sheaths, and in the tunnels of the moth-borer, and repeatedly noted it attending the yellow aphid of sugar-cane, *Sipha flava* Forbes,

in various parts of the Island. Most recent intensive observations were to show "The Ant, *Monomorium carbonarium ebeninum* Forel, in a new Role, as Predator on the Egg-Clusters of *Diatraea saccharalis* F., in Puerto Rico Cane Fields" (Jour. Agr. Univ. P. R., **21** (4): 577–79. San Juan, October 1937), attacking about one-sixth of the nine thousand egg-clusters examined. No records are available of birds eating this little black ant, but it is eaten by the lizards *Anolis stratulus* and *Anolis cristatellus*. Mr. E. G. Smyth found it "injurious to the fruits of the roselle, *Hibiscus sabdariffa*, by nesting in them", and it has been found nesting in a cabbage head, tunneling among the inner leaves, as well as nesting under cow dung, at Río Piedras. Dr. M. R. Smith, collecting it at Lares, Las Marías and in the coffee groves back of Mayagüez, found it attending both the green and hemispherical scales, the workers being exceedingly fond of honeydew. In a poisoning experiment conducted against the hormiguilla in a tree of "guamá" (*Inga laurina*) at Mayagüez, large numbers of hormiga brava, coming up from the ground to fight the hormiguilla as to who should possess the thallium-poisoned meat, won a phyrric victory. Enormous numbers of dead of both kinds of ants eventually covered the ground beneath the tree bearing the poisoned bait. A few months later, the empty and deserted hormiguilla tunnels were found inhabited by *Monomorium carbonarium ebeninum*.

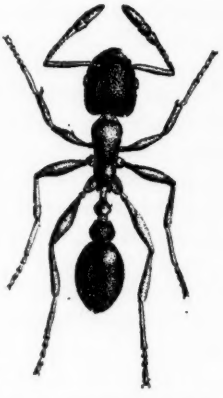
Monomorium destructor (Jerdon) "in its native country (India), is, like the rat, instrumental in disseminating the bubonic plague" according to Dr. Wheeler. He found only a single colony, at Tallaboa, at the base of an acacia tree, on the trunk of which the workers were moving in files up and down. Mr. R. H. Van Zwaluwenburg first collected it at Mayagüez, where Dr. M. R. Smith subsequently found a colony nesting in a bakery. Dr. H. L. Dozier collected it at Guayama, Ponce and Sábana Grande. It does occur on the north coast however, or at least the lizard *Anolis pulchellus*, found it there. "Workers may be recognized by their yellowish color, their shining bodies, and by the fact that they are highly polymorphic."

Monomorium floricola (Jerdon), noted by Dr. Wheeler as "common in Tillandsias, under bark scales of trees and in hollow twigs," is primarily a forest species, and is an item in the food of the woodpecker, according to Dr. Wetmore. Sometimes it inhabits the vacated cocoon of the "plumilla" (*Megalopyge krugii* Dewitz) quite the most snug and secure dwelling that any little ant could wish. It has been found in an empty moth-borer tunnel in a sugar-cane stalk, and also living in the pods of native lima beans. Dr. Luis F. Martorell found it nesting in a stump on Mona Island. We have most records of its nesting in the hollow twigs of coffee trees, at Lares, Peñuelas, Sabana Grande and San Germán. Dr. M. R. Smith noted it

obtaining honeydew from the green and hemispherical scales on coffee at Mayagüez, and carrying away dead insects.

Monomorium pharaonis (L.), a pale yellowish ant, most often found in urban areas, was noted by Dr. Wheeler nesting outdoors in the ground near the old government house of Culebra Island, and Prof. J. A. Ramos found it on Uvero Beach, Mona Island. Seven individuals were found in three square feet of pasture at Pt. Cangrejos, when that was still country and not a suburban development. All other records: at San Juan, Río Piedras, Arecibo and Mayagüez, are of occurrence in houses. It is, however, an item in the food of the little grass lizard, *Anolis pulchellus*.

Cardiocondyla emeryi Forel. (Drawn by R. B. Howe.)



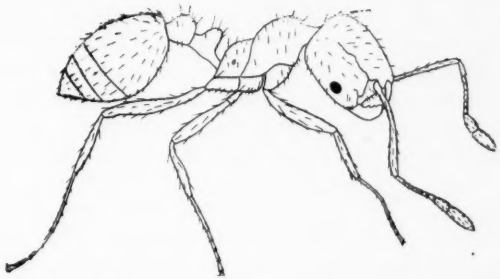
Cardiocondyla venustula Wheeler. (Drawn by R. B. Howe.)

Cardiocondyla emeryi Forel, a very small light reddish brown ant, originally described from St. Thomas, was found by Mr. August Busck on Vieques Island, by Dr. Wheeler on Culebra, and most recently by Prof. J. A. Ramos (1947–65) on Mona Island. It has been noted at many points in Puerto Rico, but "due to the extremely small size of the worker and its habit of commonly foraging alone, the species is often overlooked by the collector." The little grass lizard, *Anolis pulchellus*, did not find them too small to be overlooked as a source of food, and Dr. Wetmore notes this ant as being eaten by the woodpecker. Dr. H. L. Dozier found workers under dry cow dung at Sabana Grande and Lajas.

Cardiocondyla venustula, described by Dr. Wm. Morton Wheeler (1908–128) from small colonies on the beach of Culebra Island, and from winged females emerging from a nest in a gravelly creek bottom at Coamo Springs

on March 23d, 1906, was subsequently collected on Mona Island by Dr. Frank E. Lutz, according to Dr. M. R. Smith writing on the "Ants of the Genus *Cardiocondyla* Emery in the United States" (Proc. Ent. Soc. Washington, **46** (2): 30–41, pl. 1. Washington, D. C., February 1944) Dr. H. L. Dozier found workers in dry cow dung in very arid pasture areas at Ponce and Coamo. It is not common, altho eaten by the lizard, *Anolis pulchellus*, and by the swallow, according to Dr. Wetmore.

Solenopsis azteca Forel, of which the variety **pallida** was described by Dr. Wm. Morton Wheeler (1908–131) from a number of workers taken from a small nest in a dry stream bed at Coamo Springs, has "the body and appendages yellow, the head with a reddish brown cloud on the vertex." Dr. M. R. Smith found workers and winged queens on December 13th, 1935, just beneath the bark of stumps and logs in a coffee grove at Km. 14 of the road east from Mayagüez.



The "Hormiga Brava," *Solenopsis geminata* (Fabricius), worker, about twenty-five times natural size. (Drawn by F. Seín.)

Solenopsis corticalis Forel, originally described from St. Thomas, was found by Dr. Wheeler in a stem of bamboo at Utuado, by Dr. Smith in a coffee grove 16 Km. east of Mayagüez, and attending the pineapple mealybug in a pineapple field at Lajas.

Solenopsis geminata (Fabricius), the all too well known "hormiga brava", is characterized by Dr. Wheeler as being "so prolific, versatile and aggressive, and so fond of living in cultivated fields and in the neighborhood of human dwellings, that it has probably prevented many introduced species from extending their range, or even from gaining a foothold." "The meagerness of the native ant-fauna of Porto Rico and Culebra, may also, I believe," continues Dr. Wheeler, "be attributed in great measure to the aggressive habits of *S. geminata*. This ant prefers to nest in open sunny places and especially in sandy or loamy soil. It is much less frequent in shady woods or damp spots." "This ant not only stores up seeds in its

nests and is highly carnivorous, but it also attends aphids and coccids. In Culebra I found it visiting aphids on the leaves of the superb milk-weed, *Calotropis procera*, and in several localities in this island and in Porto Rico it was seen attending coccids on the roots of grasses and on the bark of trees." On Mona Island, it is abundant on the trees of beefwood (*Casuarina equisetifolia*) near Camp Kofresí, attending cottony cushion scale, and doubtless is in part responsible for the initial abundance of this scale when first found on Mona. Dr. M. R. Smith notes that "although this ant prefers to nest in open sunny places, its nests on some occasions are found in lightly shaded woods. The typical nest is a mound of loose earth with several entrances leading into it, but the ants may nest in the soil beneath cow dung. Their colonies are composed of thousands of individuals. Fertile, dealated queens are capable of starting colonies unaided." The mound of loose earth over the nest soon becomes packed down by tropical rains, so that it may remain unnoted for months, only to be renewed again, or as often abandoned for a fresh mound constructed a few feet away. The workers move large amounts of earth in this way, and by comparison, the sheds they build around the cottony cushion scale on citrus or over the brown sugar-cane aphids, *Hysteroneura setariae* (Thomas), on young cane shoots just above the surface of the ground, or over pineapple mealybugs, are but minor structures. The publications by Mr. O. W. Barrett on "Control of the Brown Ant (*Solenopsis geminata* Fabr.) in Orange Orchards" (Circ. No. 4, P. R. Agr. Expt. Station, pp. 3. Mayagüez, May 9, 1904), and by Mr. W. V. Tower on the "Control of the Brown Ant (*Solenopsis geminata* Fabr.) and the Mealybug in Pineapple Plantations" (Circ. No. 7, P. R. Agr. Expt. Station, pp. 3. Mayagüez, 1908), indicate how important to the early citrus and pineapple growers was some means of control of this pest.

The abundance of the hormiga brava is to some extent indicated by the fact that Dr. Alex. Wetmore found that it had been eaten by the killdeer, ani, tody, mango, oriole, mozambique and grasshopper sparrow. It is more often eaten by lizards than is any other ant, having been noted in the stomachs of *Ameiva exsul*, *Anolis pulchellus*, *A. stratulus* and *A. cristatellus*. One hundred, twenty-two workers were found in three square feet of pasture at Pt. Cangrejos, altho no nest was present in the area examined. This sandy land near the beach was an optimum environment, typical of those where hormiga brava occurs in such numbers that to obtain sufficient food it not only eats all dead insects, and collects honeydew from aphids, mealybugs and soft scale insects, but, bypassing such intermediate agents, chews into the bark of young citrus trees where they have been grafted, and obtains the cell sap directly. Eggplants are attacked in the same way, and if not enough exudations occur on young corn leaves to satisfy the ants,

they stimulate their flow by biting into the tissue of the leaves. They carry away seeds, especially that of lettuce and tobacco, thus often necessitating the use of platform beds if any plants are to have a chance to grow.

The aggressiveness of hormiga brava in attacking other ants has already been noted by Dr. Wheeler. The occupation by *Monomorium carbonarium ebeninum* of hormiguilla tunnels of which their former tennants had been killed by hormiga brava was noted at Mayagüez, but in a hormiguilla-infested tree at Río Piedras on which thallium-poisoned meat baits had been placed, the hormiguilla decisively defeated the hormiga brava in the contest as to which should have possession of this toxic prize. These exceptional instances of inter-ant warfare merely happened to be observed; numerous comparable cases of contests with other ants are occurring all the time, but fail to be noted by the human observer.

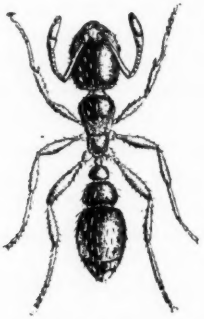
The reckless courage with which hormiga brava attacks other ants is matched by that with which single workers unhesitatingly bite human beings, as is attested by the well merited name of B R A V A. Mrs. Sophie D. Griffitts, of the Department of Bacteriology of the School of Tropical Medicine in San Juan, apparently unaware of Dr. Wheeler's note on the role of *Monomorium destructor* is disseminating the bubonic plague in India, implicates *Solenopsis geminata* as the only one of the "Ants as probable Agents in the Spread of Shigallia Infections" (Science, **96** (2490): 271–2. Lancaster, September 18, 1942), finding that they "may carry bacteria on their feet from one place to another for at least 24 hours after feeding on or traversing infected material."

Dr. Neal H. Weber has reported on "The Food of the Giant Toad, *Bufo marinus* (L.) in Trinidad and British Guiana with special reference to the Ants" (Annals Ent. Soc. America, **31** (4): 499–503, ref. 3. Columbus, December 1938). In Puerto Rico, the fully-grown adult toads eat ants only incidentally, the great bulk of their food being beetles and millipedes. The "zapitos" or very small adults, just transformed from the pollywog stage, are much too minute to swallow such large items of food, and Mr. Mario Pérez has found that their food consists largely of mites, springtails, nymphal leafhoppers and planthoppers, just hatched caterpillars, and ants. Any small ant will serve, but because hormiga brava is so common, it is more extensively eaten than any other. Admittedly, many zapitos would be required to eliminate even one colony of hormiga brava, but when abundant they may be a definite factor in biological control.

Solenopsis geminata affects man in so many ways, all of them to his disadvantage, that methods of control were sought by the earliest economic entomologists working in Puerto Rico. The crudė carbolic acid emulsion recommended by Mr. W. V. Tower for use in the field is still one of the best and cheapest, altho DDT, chlordan and chlorinated cam-

phene give equally good results. Thallium sulfate baits are useless in the field, but in houses will serve to keep the ants out under ordinary conditions. Cyanogas flakes kill most of the workers in nests when applied directly, but do not kill the queen and workers deep in the ground, their effect being only superficial and essentially temporary. This is true, however, of all chemicals so some extent, for even if the original colony is destroyed, other ants come in to occupy the deserted tunnels, or to construct new ones in unoccupied territory. The competition for land is as keen among ants in Puerto Rico as it is among people, and destroying the ants present anywhere merely gives an opportunity for invasion by others shortly afterward.

Of the numerous chemicals recently developed which are effective in killing ants, none acts so promptly and in such minute amounts as technical



Solenopsis borinquenensis Wheeler. (Drawn by R. B. Howe.)

Hyman 118 or aldrin, quite incredible to one familiar only with the slowness and inadequacy of the crude carbolic acid emulsion. Within a few minutes after a pinch of the grannular powder is applied to the nest just broken open, the ants disappear without even attempting to bite, and they never reappear.

Ordinary people have little difficulty in recognizing *Solenopsis geminata* when it bites them, but of its morphological characters, Dr. M. R. Smith notes that "the worker is polymorphic, highly variable in color, ranging from reddish brown to black, glabrous, possesses a 2-segmented antennal club, and has no epinotal spines."

Solenopsis globularia (F. Smith) has workers considerably lighter in some parts of the body which were described and illustrated by Dr. Wm. Morton Wheeler (1908–131) as the variety **borinquenensis,** taken from "nests in the white sand of the sea-beaches just above high-water mark"

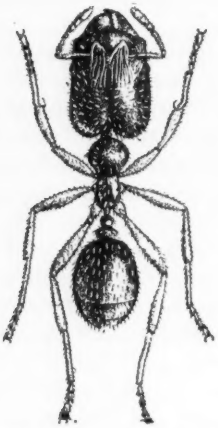
at El Morro in San Juan, and on Culebra Island. Workers of the variety **desecheoensis,** described by Dr. Wm. Mann on page 428 of "Additions to the Ant Fauna of the West Indies and Central America" (Bull. Amer. Mus. Nat. History, **42** (8): 403–439. New York, 1920), have a jet black body and yellowish brown appendages, and are apparently much more abundant generally, or at least in the western end of the Island. Dr. H. L. Dozier collected them repeatedly under dry cow dung at Lajas, Ensenada, Guánica Lagoon and at Coamo, and Dr. M. R. Smith found them on the sandy beach at Mayagüez.

Solenopsis picea Emery has workers which are very dark and glabrous. This species was found only once in Puerto Rico: by Dr. Wm. Morton Wheeler "from a single colony nesting under the bark of a rotting log" at Utuado.

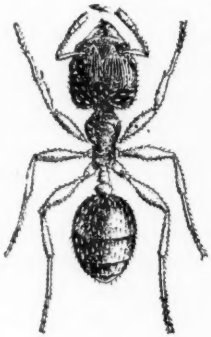
Pheidole fallax jelskii Mayr, variety **antillensis** Forel, which Dr. Wheeler describes as having a "color more vivid" than that of some of the other varieties, he collected on Culebra Island, and in Puerto Rico from El Morro at San Juan to Utuado and the higher mountains. Mr. R. H. Van Zwaluwenburg made the first collection from the Mayagüez region, where subsequently Dr. M. R. Smith found it one of the most common of ants, its range extending as high as 3,000 feet in the Maricao Forest. Dr. H. L. Dozier made repeated observations on it under dry cow dung in the more xerophytic parts of the Island. Its workers attack other insects many times their own size, having been observed to attack and kill a live and apparently normal changa, *Scapteriscus vicinus* Scudder, and a large and powerful female Scoliid wasp, *Campsomeris dorsata* Fabricius. "Their food is largely flesh" states Dr. Smith, "and so strongly does this predominate that the ants have a distinctly fecal odor. I have noted the workers on several occasions attending the green and hemispherical scales (on coffee), and the aphid, *Pentalonia nigronervosa* Cockerell, on bananas, thus indicating that the diet of this ant is not entirely flesh. The nest is easily recognized by the peculiar elongate, slit-shaped entrance holes." Of a colony at Río Piedras, Mr. E. G. Smyth noted that the entrance was "usually more than an inch across in one direction and less than quarter of an inch in the other; the earth is carried so far from the burrow that there is no semblance of an ant-hill. A number of the ants were found dragging a live cutworm (*Feltia annexa*) towards their burrow, the large-headed soldiers giving invaluable assistance in this work, and they have been observed more than once bodily dragging the still living larvae of *Pieris monuste* and *Melanchroia cephise* from their food plants and carrying them to their nests." Dr. Wetmore found that this ant had been eaten by the mockingbird, thrush and mozambique, and Mr. A. H. Madden found it in the stomach of the Surinam toad, *Bufo marinus*. It is eaten by four species of lizards: *Anolis pulchellus*,

A. krugii, A. stratulus and *A. cristatellus.* It has been found that this ant "harbors the intermediate or cystic stage of the tapeworms of the *Raillientina* group in the chicken," according to the 1938 Report of the Experiment Station at Mayagüez.

Pheidole flavens Roger subspecies **exigua** Mayr, redescribed by Dr. Wheeler (1908–134) from three females and numerous soldiers and workers from colonies under stones and logs in the open woods and cafetals of Utuado and the higher mountains to the south, was found by Dr. Smith only in coffee groves between Maricao and Mayagüez. Mr. J. D. More identified specimens collected at Cayey on *Inga vera* as being this species.



Pheidole subarmata borinquenensis Wheeler: soldier. (Drawn by R. B. Howe.)



Pheidole moerens Wheeler: soldier. (Drawn by R. B. Howe.)

Of the subspecies **sculptior** Forel, Dr. Wheeler found only a single soldier at Coamo Springs, but Dr. Smith observed colonies in rotten stumps in coffee groves, and on the sandy soil of the beach at Mayagüez, beneath a coconut husk.

Pheidole moerens was described by Dr. Wheeler (1918–136) from numerous specimens taken under stones and prostrate plantain trunks in the woods and cafetals of the Utuado region and the higher mountains to the south. It also occurs on Culebra Island, and Prof. J. A. Ramos found it on Mona Island, "under stones at the base of the cliffs." Despite these records, it would appear to be primarily a mountainous species, found most

often in coffee groves and in virgin forest as high as 3,000 feet, Dr. Smith having collected it in the Maricao Forest.

Pheidole megacephala (F.), a cosmopolitan, imported species, lives mostly in urban environments, and has been noted at Río Piedras in successful combat with *Solenopsis geminata*, for a time at least extending its colonies and hunting range where hormiga brava had previously been firmly established. Dr. Wheeler notes that "the most careful search failed to reveal the presence of *Ph. megacephala* in Culebra, but in the little island of Culebrita, less than a mile to the eastward, it is in full possession to the exclusion of every other ant. Here I found it everywhere: in the masonry walls of the lighthouse on the highest point on the island, under stones and logs throughout the thickets and in crater nests on the beaches of the foraminiferous sand down to the high water mark. It is probable that it had

Pheidole subarmata borinquenensis Wheeler: worker. (Drawn by R. B. Howe.)

Pheidole moerens Wheeler: worker. (Drawn by R. B. Howe.)

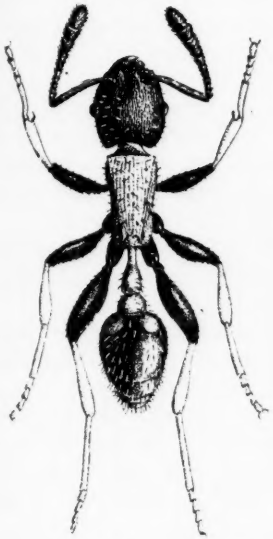
been prevented by *Solenopsis* from gaining a foothold in Culebra, for I can hardly believe that winged females of *Pheidole* have been unable to cross the narrow channel which separates the two islands. In Porto Rico, *Ph. megacephala* is so sporadic in its occurrence as to suggest either that it has been introduced at several widely separated points and has been unable to spread, or that it has been exterminated over a large portion of its range by the fire-ant." Dr. Wheeler identified specimens collected at Río Piedras by Mr. Thos. H. Jones, who found them attending mealybugs on sugar-cane in 1912, and the large and vigorous colony noted in the yard of a house opposite the Plaza del Mercado in 1921 was apparently extending its range at that time, but no recent collection has been made at Río Piedras. Dr. Smith's observations are based on a single colony in his back yard at Mayagüez, and interceptions have been made in ginger roots at

San Juan; attending aphids on lima beans at Loíza, and at Arecibo with no data as to environment. Certainly Dr. Wheeler's prediction as to the losing fight it was waging against hormiga brava was correct, if one may judge by the scarcity of recent records of its presence in Puerto Rico.

Pheidole subarmata Mayr, of which Dr. Wheeler (1908–133) described the "dark chestnut brown" variety **boriquenensis** from Puerto Rico, illustrating soldier and worker, occurs with "only a few soldiers and workers in a colony, in sandy, sunny places like roads and creek bottoms." It is a rather common species, which Dr. M. R. Smith (1936–844) found nesting in both clay and sandy soils, attending the green and hemispherical scales, and the aphid *Pentalonia nigronervosa* Cockerell on plantains. Dr. H. L. Dozier found soldiers and workers common in cow dung. Mr. A. H. Madden noted them feeding on the eggs and nymphs of the changa, *Scapteriscus vicinus* Scudder, and eaten by the Surinam toad. They are also caught by the crested lizard, and Dr. Wetmore found then eaten by the grasshopper sparrow.

Crematogaster steinheili Forel, listed by Dr. Wheeler as *Crematogaster victima* F. Smith, variety *steinheili* Forel, is stated by him to be "common; nesting in Tillandsias, under bark or in the hollow twigs of various trees," but none of his collections: at Coamo Springs, Vega Baja and Aibonito in Puerto Rico, and on Culebra Island, was from the xerophytic part of the Island where this ant is really abundant. It is distinctively characterized by a brownish, heart-shaped abdomen, sharply pointed at the apex, which it elevates almost vertically when running about, with the remainder of the ant light yellowish in color. Most of our records are of occurrence on the south coast: repeatedly under the bark of lignum-vitae or "guayacán" (*Guaiacum officinale*), the ants arranged about the margin of the bark-scale with their heads out; under loose bark of mahogany (*Swietenia mahagoni*) at Guayama; nesting in stump at Ponce; attending mealybugs on wild croton at Yauco; attending *Crypticerya rosae* Riley and Howard on lignum-vitae at Guánica and attending the soft scale, *Coccus hesperidum* L., on papaya leaves (*Carica papaya*) at Guánica. This particular soft scale seems to be preferred by these ants, for they have also been noted attending it on papaya leaves at Luquillo and at Río Piedras. In all cases when attending soft scales or mealybugs carton nests had been built by the ants, comparable to those reported by Dr. Wheeler on Culebra over unspecified species of coccids on both surfaces of the large shining leaves of the "moral" tree, *Cordia sulcata* (= *C. macrophylla*). Dr. Smith "found the ants in some of the driest areas of the Island, at Ensenada, Guánica and Lajas, as well as some of the most moist: at San Germán and Mayagüez, hence am led to conclude that it is a highly adaptable species." He found it attending the aphid *Aphis gossypii* Glover, and the mealybugs

Pseudococcus nipae (Maskell) and *P. brevipes* (Cockerell). In the more humid parts of the Island, it has been observed attending the aphid *Toxoptera aurantii* Fonscolombe on water-shoots of "mamey" (*Mammea americana*) at Isabela Grove, Pt. Salinas; nesting in dead coffee twigs between Guayama and Jájome Alto; abundant on "jagüey" (*Ficus laevigata*) at Maunabo; abundant on cotton at Villalba; and nesting in empty cocoon of the "plumilla," *Megalopyge krugii* (Dewitz), in citrus tree at Fajardo.



Macromischa isabellae Wheeler. (Drawn by R. B. Howe.)

Macromischa albispina Wheeler. (Drawn by R. B. Howe.)

Macromischa isabellae, described by Dr. Wm. M. Wheeler (1908–138) from type material collected at an elevation of 3,000 feet, at the summits of Monte Morales and Monte Mandios, from colonies under the roots of an epiphytic orchid and in a hollow twig, he took "great pleasure in dedicating this, the most beautiful of Porto Rican ants, to Mrs. Elizabeth G. Britton." Subsequent collections have been made at Indiera, between Yauco and Maricao, on coffee and coffee shade trees, and nesting in an old stump. Its workers have hairs which are "snow-white, sparse and erect; mandibles, antennae, head, coxae, femora and gaster blue black; the first gastric segment with a brilliant satiny reflection, visible only in certain lights; thorax,

petiole, post-petiole and trochanters dull orange red; tips of mandibles, tibiae, tarsi and two elliptical spots at the base of the first gastric segment, honey yellow." Dr. M. R. Smith found typical specimens at Las Mesas, near Mayagüez, at an elevation of only 800 feet. From workers in the Maricao Forest, characterized by the "absence of epinotal spines," he described (1936–847) the subspecies **mutica.**

Macromischa albispina, described by Dr. Wheeler (1908–139) from Culebra Island, is almost entirely blue-black in color with white epinotal spines. The type material was of "thirty workers and a single female, (which) represented a single colony found nesting in a small cavity in the ground in the shade of a thicket." It does not occur in Puerto Rico and no interested person has since visited Culebra to look for it.

Macromischa albispina pallipes Wheeler, mentioned by Dr. Wm. Mann (1920–424) as a variety of *albispina*, but since raised to subspecific status by Dr. Wheeler, occurs only on Mona Island, and was most recently collected there by Prof. J. A. Ramos. Its legs, antennal scapes and mandibles are yellowish white.

Rogeria curvipubens Emery, as identified by Dr. M. R. Smith, was found by him at Ensenada. It is a small, dark reddish-brown ant, originally described from St. Thomas.

Tetramorium guineense (F.), of which numerous workers were observed by Dr. Wheeler eating the ripe and broken fruit of papaya on Monte Resaca on Culebra Island, was soon after found in Puerto Rico by Mr. D. L. Van Dine in moth-borer tunnels in sugar-cane at Yabucoa. Dr. H. L. Dozier collected it on cow dung at Humacao and Hatillo, and Dr. M. R. Smith found it on the Station grounds at Mayagüez and at near-by Maní Beach. Twice it has been intercepted in houses in San Juan, and Prof. J. A. Ramos found in on Mona Island.

Tetramorium lucayanum Wheeler, as identified by Dr. M. R. Smith, was found by him in an old stump in a coffee grove near Mayagüez and on the floor of a barn on the Station grounds. It is a shining black ant, originally described from the Bahamas.

Tetramorium simillimum (F. Smith), a very small yellow ant, was found by Dr. Wheeler on Culebra "nesting under stones and logs on the beach," and in Puerto Rico only at Coamo Springs in the creek bottom. It has since been intercepted at San Juan, and the lizard, *Anolis pulchellus,* has collected it for food at Río Piedras. It is possibly more abundant in the western end of the Island, for Dr. M. R. Smith reports numerous collections by himself, and by Dr. H. L. Dozier under cow dung.

Wasmannia auropunctata (Roger), the "albayalde," has a sting which is more painful and decidedly more lasting, for most people, than that of any other tropical ant. Dr. Wheeler, recording the occurrence of this ant

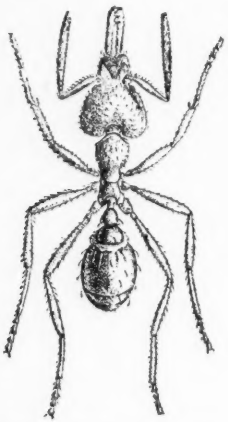
on Culebra Island, and in Puerto Rico from El Morro at San Juan to the tops of the mountains, and especially in the coffee groves at Utuado and Adjuntas, makes no mention of this, its most obvious characteristic. Because this little yellow ant is so small, and because it is so slow to anger, it gets under the clothes of coffee pickers unnoted, and bites the tenderest and least exposed parts of the human anatomy. Not only do the peones refuse to pick coffee where these ants are known to be abundant, but they will not even attempt to enter such areas, which, in effect, are abandoned to the "albayalde." Mr. R. H. Van Zwaluwenburg reports the albayalde as killing out and displacing colonies of hormiguilla in coffee. Its workers are slow and deliberate in their movements, and, like soldiers going up to the front, proceed at widely spaced intervals along the coffee stems. This is not from fear, or danger of attack, for no coffee picker will knowingly

The "Albayalde," *Wasmannia auropunctata* (Roger). (Drawn by R. B. Howe.)

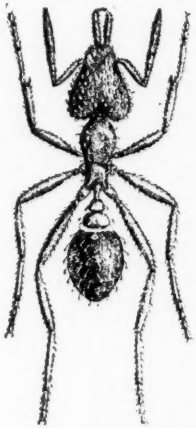
disturb them, if their presence is observed in time. However, the typical coffee grove-inhabiting birds readily eat them, Dr. Wetmore reporting them in the stomachs of the swift, the swallow, the oven-bird and the parula warbler. All six species of lizards of the genus *Anolis* eat them in considerable abundance. Altho the albayalde is thought of as being characteristically of coffee groves, actually it is present in all the more humid parts of Puerto Rico, and five individuals were found in three square feet of sandy pasture near the beach at Pt. Cangrejos. Dr. Luis F. Martorell found them on the ground near Camp Kofresí on Mona Island. The early entomologists specializing on sugar-cane found the albayalde repeatedly attending mealybugs on sugar-cane, and the yellow aphid, *Sipha flava* Forbes. Mr. J. D. More found this ant entering small holes in the buds of sugar-cane. In the coffee groves, the albayalde, formerly attending only mealybugs and the aphid, *Toxoptera aurantii* Fonscolombe, greatly favored the rapid multiplication and spread of the green scale, *Coccus viridis*

(Greene), when that pest first appeared in Puerto Rico. The cottony cushion scale, *Icerya purchasi* Maskell, was promptly adopted by the albayalde for its especial care on citrus trees, when it was accidentally introduced. Indeed, from the standpoint of man, the albayalde has nothing to recommend it, but until recently no method of control gave promise of any value, and it is yet to be demonstrated on a field scale that DDT or chlordan or aldrin will be as effective as small scale tests indicate.

Strumigenys eggersi Emery, originally described from St. Thomas, was not found in Puerto Rico by Dr. Wheeler, but Dr. M. R. Smith reports "a dealated queen beneath a rock in the Maricao Insular Forest at an altitude of 3,000 feet" and the discovery by Mr J. W. Balock of a colony of about thirty individuals under cow dung in a pasture at Juana Díaz.



Strumigenys rogeri Emery. (Drawn by R. B. Howe.)



Strumigenys obscuriventris Wheeler. (Drawn by R. B. Howe.)

Strumigenys rogeri Emery, originally described from St. Thomas, Dr. Wheeler discovered in colonies nesting under stones in the dry stream bed at Coamo Springs. It is possibly the most abundant of the genus in Puerto Rico: a little yellow ant with large head and prominent mandibles. Dr. Alex. Wetmore found it eaten by the mozambique, and presumably it was this species which was found eaten by the crested lizard. Dr. M. R. Smith notes colonies at Arecibo and Mayagüez, in stream beds and in coffee groves.

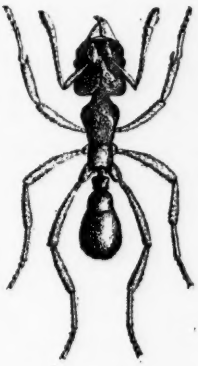
Strumigenys louisianae Roger, of which Dr. Wheeler described (1908-145) the Puerto Rican variety under the name of **obscuriventris,** with

"the gaster, except at the base, dark brown or black, and the ferruginous tint of the body in general darker," is a continental species from the Gulf Coast states, with very elongate mandibles. Dr. Wheeler found a few isolated individuals at Utuado under prostrate plantain trunks and several colonies in the dry stream bed at Coamo Springs. Dr. M. R. Smith noted colonies nesting in soil beneath stones at Mayagüez and at Ensenada.

Of **Trichoscapa membranifera** subspecies **simillima** (Emery), as determined by Dr. M. R. Smith, a single worker was collected under dry cow dung at Lajas by Dr. H. L. Dozier.

Quadristruma emmae (Emery), originally described from St. Thomas, was found by Dr. M. R. Smith in small numbers in Puerto Rico: two workers at Ensenada and a single individual at Arecibo.

Mycocepurus smithi (Forel). (Drawn by R. B. Howe.)



Mycetophylax brittoni Wheeler. (Drawn by R. B. Howe.)

Mycetophylax brittoni, described as *Myrmicocrypta* by Dr. Wheeler as one of "The Fungus-Growing Ants of North America" (Bull. Amer. Mus. Nat. History, **23** (31): 669–807, fig. 31, pl. 5. New York, September 30, 1907) from numerous opaque, black workers with yellowish mandibles collected by him in Santurce, has not since been found.

Cyphomyrmex rimosus (Spinola), subspecies **minutus** Mayr, collected by Dr. Wheeler on Culebra, and in Puerto Rico from Arecibo on the coast to the crest of the highest mountains, is comparatively common in all parts of the Island. It was first noted under cow dung at Río Piedras by Mr. Thos. H. Jones, and subsequently by Dr. H. L. Dozier at Hatillo and San Germán, but its small colonies occur more often under rotted stumps and logs. Dr. Smith notes that "the workers of this ant, because of its small

size and resemblance in color to the soil, is not always easy to see, and furthermore the ants have the habit of feigning death. Their food consists of yellowish, pear-shaped bodies of fungus."

Mycocepurus smithi (Forel), of which Dr. Wheeler (1907–718) described the variety **borinquenensis** from specimens collected at Vega Baja, Arecibo, Utuado and Monte Mandios, was observed in the western end of the Island by Dr. Smith. As the lizards *Anolis pulchellus* and *Anolis stratulus* were found to have eaten this ant in appreciable numbers, it is possibly much more abundant than the few collections by entomologists would indicate.

Trachymyrmex jamaicensis (André) was found by Dr. Wheeler on Culebra Island, and Prof. J. A. Ramos (1947–66) collected it on Mona Island. Both it and the preceding species were formerly considered to be

Atta sexdens (Linnaeus), the Fungus-Growing or "Parasol" Ant of South America, twice natural size. (After Wolcott.)

of the genus *Atta*, but their former sub-generic names have now been raised to generic status. In Trinidad and Cuba, destructive species of fungus-growing or "parasol" ants do enormous damage in defoliating citrus, cacao, mango and other economic trees, but no comparable species of *Atta* exists in Puerto Rico.

Dolichoderinae

Tapinoma melanocephalum (F.), most intimately and unfavorably known to the householders of Puerto Rico as a stinking little ant called "albaricoque," not only has a black head, as is indicated by the scientific name, but also a black thorax. The gaster is whitish. Other ants invade houses now and then, and can be repelled with the thallium baits, but

the ubiquitous albaricoque is irrepressible. It is continually drowning itself by the dozen in water bottles, with an island of its corpses forming on the water film, ever increasing in size if undisturbed, for the ants never seem to learn how to avoid being drowned. Most fortunately, the aerosol pyrethrum and DDT sprays not only kill the ants immediately, but usually are effective in preventing the return of their comrades for some time at least. Dr. Wheeler mentions their "nesting under stones and under the bark of trees" on Culebra, and at Ponce, Tallaboa, Utuado and Arecibo in Puerto Rico. At the present time the ant is common in all urban areas, much less often occurring out in the country, and hardly at all in virgin forests. In the three square feet of pasture area examined at Pt. Cangrejos, seventy-four individuals were found. Prof. J. A. Ramos found the albaricoque nesting in a rotten stump of *Coccoloba laurifolia* on Mona Island. Dr. Smith notes their attending the pineapple mealybug and the green scale on coffee, but they are more often seen carrying away dead insects, or attacking helpless, inactive stages, such as pupae. Albaricoque has been noted eaten by the lizards *Anolis evermanni*, *A. pulchellus* and *A. cristatellus*.

Tapinoma littorale Wheeler, originally described from the beaches of the Bahamas and southern Florida, is a singularly inappropriate name for this ant in Puerto Rico, which Dr. Wheeler found only at Monte Morales and Monte Mandios at an altitude of 3,000 feet, nesting in hollow twigs and bushes. This is indeed its true habitat, for Dr. H. L. Dozier made collections at Doña Juana, and Dr. M. R. Smith in the Maricao Forest, at Maricao, and between Maricao and Mayagüez. It has been intercepted at Aguas Buenas, but the lizards *Anolis pulchellus* and *Anolis cristatellus*, mostly from the Río Piedras region, were found to have eaten this little pale yellow ant.

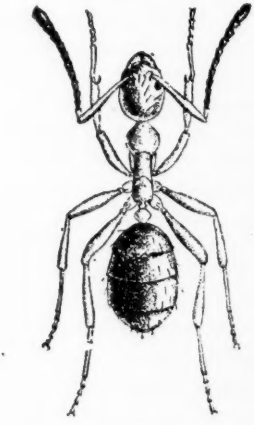
Iridomyrmex melleus, which Dr. Wm. Morton Wheeler described (1908–151) as one of the most common of the arboreal ants in the mountains of Puerto Rico, "is distinguished by its slender, graceful appearance and the general honey-yellow colored body" according to Dr. Smith. The carton nests, which Dr. Wheeler figures and describes, are built of "earth mixed with vegetable debris on the underside of the huge reniform leaves of the 'ortegón' (*Coccoloba rugosa*) in the angles formed by the thick veins with the leaf-membrane." "As they contained brood as well as the ants, they can not be regarded as aphis sheds." Such nests have been repeatedly noted on coffee trees, in the dead hollow twigs of which the ants also nest, or in the bark at the crotch, or between crossing limbs.

Don Francisco Frontera Monrroig, of Bo. Indiera Baja of Maricao, claims that this apparently inoffensive ant actually does drive out the hormiguilla (*Myrmelachista ramulorum*) from its tunnels and occupy the

tunnels itself. If this does occur, it does not happen often enough to be of much importance in the control of hormiguilla.

At Río Piedras and at Aibonito, colonies have been found in the empty cocoons of the "plumilla," *Megalopyge krugii* (Dewitz), and Dr. Luis F. Martorell has observed colonies in dry twigs of "galán del monte" (*Cestrum laurifolium*) at Aibonito. Dr. M. R. Smith found the workers attending mealybugs on Tillandsias, the green and hemispherical scales and the aphid, *Toxoptera aurantii* Fonscolombe, on coffee. These ants have been found in the stomachs of the lizards *Anolis pulchellus* and *Anolis stratulus*. A variety of this ant described by Dr. Wheeler (1908–153) as **fuscescens** has "the body and appendages fuscous, the gaster black, the mandibles yellow and the tarsi whitish." The type material was from Monte Morales and Monte Mandios. Dr. Smith found this variety in the Maricao Forest in the axils of the leaf-sheaths of the sierra palm, *Euterpe globosa*.

Iridomyrmex melleus Wheeler. (Drawn by R. B. Howe.)



Iridomyrmex melleus Wheeler. (Drawn by R. B. Howe.)

Dorymyrmex pyramicus (Roger) variety **niger** Pergande, a medium-sized black ant having "a sharp and pointed conical elevation on the epinotum" is common, according to Dr. Wheeler, "in sandy and sunny places in nearly all the localities visited in Porto Rico, but could not be found on Culebra." On Mona Island, Dr. Luis F. Martorell found it nesting in a stump and attending the cottony cushion scales on the beefwood (*Casuarina equisetifolia*) trees near Camp Kofresí. Since its collection by Dr. Wheeler at Vega Baja no other record occurs of its existence in the eastern end of Puerto Rico, not even the lizards being able to find it,

nor did Dr. Smith note it at Mayagüez, his records being from San Germán southward. In January 1923, workers were found in abundance on cotton growing at Boquerón.

Formicinae

Brachymyrmex heeri Forel, originally described from St. Thomas, was found by Dr. Wheeler at Santurce and Utuado in Puerto Rico, as well as on Culebra. Mr. R. H. Van Zwaluwenburg first noted it at Mayagüez, and Dr. Smith also found it there and in several near-by localities and up into the Maricao Forest, attending mealybugs on pineapples and on coffee shade trees, as well as all the aphids and fleshy scales occurring on coffee. It is not at all common in the eastern end of the Island, but the lizards *Anolis pulchellus* and *Anolis cristatellus* from the Río Piedras region found some to eat.

Brachymyrmex heeri var. **obscurior** Forel, "a darker form, with very similar but apparently more epigaeic habits," according to Dr. Wheeler, is locally much more abundant. Mr. Thos. H. Jones found it attending the yellow aphid of sugar-cane, *Sipha flava* Forbes, at Río Piedras, and Dr. Smith gives a long list of aphids, scale insects and mealybugs from which it has been observed to obtain honeydew. "I have actually seen workers of this species with apparently uninjured and healthy pineapple mealybugs in their mouths" he states.

Paratrechina longicornis (Latreille), formerly in the genus *Prenolepis* (*Nylanderia*), the "hormiga loca" or crazy ant, a shining, intensely black species with long antennae and legs, is an imported ant found mostly in urban areas. Dr. Wheeler noted it "very common in houses, gardens and fields" in Culebra, and everywhere in Puerto Rico except in the highest mountains. "The slender, long-legged *Prenolepis longicornis* shoots about like an arrow over the rocks and pavements, so that one seems to see only whirling black lines crossing one another on the ground." He must have been thinking of an arrow which constantly changes its direction of flight, to accurately describe the progress of these ants, which arrive by speedy indirection. When thallium acetate was being mixed with meat for hormiguilla poisoning experiments, the file of crazy ants across the laboratory pavement quickly discovered the meat, and gorged themselves so that their gasters were like distended globular balloons, lined with black chitinized stripes. They died by thousands, but were promptly replaced by other thousands, whenever additional fresh meat bait was being prepared, the colony seeming to suffer no appreciable loss in population despite the obvious and known mortalities. Mr. H. K. Plank, conducting "DDT Investigations" (Mayagüez Station Report for 1946, p. 32) found them effectively controlled by 5% DDT in kerosene, but their place promptly occu-

pied by other species of ants. One of the earliest records (1910) of this ant was at Caguas, where it was a most annoying pest in digging up and removing tobacco seeds from the seed-beds. More often, however, it lives on sandy beaches, especially under the older fronds of coconut palms. Only four individuals were noted in the three square feet of sandy pasture examined at Pt. Cangrejos, but on the beach at Mameyes they are enormously abundant, attending mealybugs and *Orthezia insignis* Browne on "cariaquillo" (*Lantana camara*). On the beach at Mona Island around Camp Kofresí, they had become established while the camps were inhabited, but it remains to be seen how long they will survive now that the Island has been so nearly deserted by man. In reality, they do not invariably and directly depend on his presence for food, as Dr. Smith states that "they are known to attend the cotton aphid (*Aphis gossypii*), the green scale (*Coccus viridis*) and the pineapple mealybug (*Pseudococcus brevipes*)," and in a cane field they have been observed attacking a caterpillar of *Perichares phocion* (F.), that was attempting to pupate. Dr. Wetmore reports no bird eating them, but they are eaten by the lizards *Anolis pulchellus*, *A. stratulus* and *A. cristatellus*.

Paratrechina (Nylanderia) fulva (Mayr) was first noted in Puerto Rico by Mr. D. L. Van Dine, attending mealybugs on sugar-cane at Humacao. It is definitely not common, as the only subsequent collections were by Mr. L. Courtney Fife, who found it attending aphids on cotton, and by Dr. M. R. Smith, attending mealybugs on pineapples at Arecibo.

Dr. M. R. Smith (1936–868) described "four workers collected from the soil beneath a stone in a rather dense wood at Km. 14 east of Mayagüez" as **Prenolepis (Nylanderia) microps,** a strictly subterranean species of pale color and with extremely small eyes.

Paratrechina (Nylanderia) steinheili (Forel) is another rare species, of which Dr. Wheeler found but two workers, at Santurce and at Adjuntas. Dr. Smith found small colonies of these reddish-brown ants in the Maricao Forest, as well as at Mayagüez and Lajas.

Paratrechina (Nylanderia) vividula (Nylander) was found by Dr. Wheeler on Culebra and in the mountains of Puerto Rico, and small yellow workers from a nest in the stem of a banana at Maricao were determined as this species by Dr. Wm. Mann. By comparison, Mr. J. D. More identified others on coffee and on coffee shade trees at Utuado.

Camponotus ustus Forel is a large yellow ant which Dr. Wheeler found nesting in the ground under a block of beach-worn coral on Culebra Island, and in Puerto Rico in the hollow twigs of seagrape (*Coccoloba uvifera*) at El Morro in San Juan, and of other trees at Utuado and Monte Mandios. Dr. Smith found it at Ensenáda in the dead branch of a tree; at Mayagüez in stumps, posts and dead branches of trees, and in the Maricao Forest.

It has also been collected in an old stump at Utuado; in dead twigs of *Inga vera* at Utuado and at Ciales; in an old stump at San Sebastián; in coffee at Lares; in "cenizo" tree (*Tetrazygia elaeagnoides*) at Vega Baja; in hollow twigs of "abeyuelo" (*Colubrina ferruginosa*) and "aceitillo" (*Zanthoxylum flavum*) at Guajataca; and at both Isabela, Quebradillas and Ciales under the loose bark of "tortugo amarillo" (*Sideroxylon foetidissimum*). From a large stump used as a fencepost along the Manatí-Ciales road, with a big comején nest on top, when sprayed with 5% DDT in kerosene, these ants came running out of the numerous entrances of their previously unsuspected nest so rapidly that they fell to the ground. Apparently their foraging workers go out only at night, for in a wooden house at Río Piedras, many were noted each night running about, altho all kept safely hidden in the daytime. The very pale winged females collected at the base of a rotten stump on El Yunque in June 1935 were identified by Dr. Smith only as to genus.

Camponotus sexguttatus (F.) is more slender and darker in color, and apparently occurs but rarely in the western end of Puerto Rico. Dr. Wheeler found it on Culebra Island in hollow twigs of seagrape (*Coccoloba uvifera*), and of the material from El Morro, San Juan, he illustrates the carton diaphragm over the opening in the seagrape twig. The earliest collection in Puerto Rico was made by Mr. Aug. Busck at Fajardo. The dark colored workers with reddish heads were noted by Mr. Francisco Seín at Naguabo in rotten posts of "bayahonda" (*Prosopis juliflora*) imported less than three years previously from the Dominican Republic. Mr. H. K. Plank found "a colony nesting inside the dried fruits of the Frescora trees" at Loíza Aldea, and Mr. J. Sepúlveda found a colony nesting in the rotten roots of a mango tree at Mayagüez. The workers which Dr. Wheeler noted at Coamo Springs were on flowers of "bejuco de corrales" (*Serjania polyphylla*).

Myrmelachista ramulorum, described by Dr. Wm. Morton Wheeler (1908–155) as a new subspecies of *ambigua* Forel from St. Vincent, is the "hormiguilla": the only ant of economic importance of all the endemic ants of Puerto Rico. A larger and more robust subspecies: *fortior*, the type from Mona Island, others from Puerto Rico, was subsequently described by him on p. 189 of "Neotropical Ants collected by Dr. Elizabeth Skwarra and Others" (Bull. Mus. Comp. Zool., Harvard, **77** (5): 157–240, fig. 6. Cambridge, 1934). The workers are "glabrous and shining, yellowish red; gaster black; head black behind shading into red on its anterior third; antennae and legs yellow." In life, the head and gaster appear blue-black, and the ants will at once be recognized by their slow and deliberate but purposeful and inevitable movements, as their files move slowly up and down the trunks of coffee and coffee shade trees in fine

weather. During wet weather the ants stay in their tunnels inside the live twigs and branches of the trees, and in the swollen galls which develop on infested coffee trees where the branches come out from the main trunk. Safe within their tunnels they attend the mealybug *Pseudococcus citri* (Risso), and a formless pink soft scale, which, so far as we know, occurs only in hormiguilla tunnels. So devoid of character is this scale that, despite repeated submission to specialists in Coccidae, it was not named until 1922. The correct name for this distended pink "cow" of the hormiguilla is *Cryptostigma secretus* (Morrison), occurring, like the hormiguilla itself only in Puerto Rico. Injury by loss of sap caused by the mealybugs and soft scales attended by the hormiguilla is quite minor by comparison with the direct injury which the ants cause by boring in live twigs and inducing the knotty galls which form on the stems of the coffee trees: an

The "Hormiguilla," *Myrmelachista ramulorum* Wheeler. (Drawn by R. B. Howe.)

The "Hormiguilla," *Myrmelachista ramulorum* Wheeler. (Drawn by R. B. Howe.)

injury directly reflected in greatly decreased yields of coffee berries in the most heavily infested groves. Shade trees are full of dead branches, which keep continually dropping, even when there is not a breath of wind. Even the branches which are still alive are greatly weakened, as indeed is the entire coffee tree, which is easily broken off when the berries are being picked. Dr. Wheeler's types were collected in seagrape (*Coccoloba uvifera*) on the beach of Culebra Island, and at Arecibo, and additional colonies have been noted in this tree at Loíza and Dorado, and on the Island of St. Thomas, high in the hills. Dr. Wheeler also found the hormiguilla at Utuado in "ucar" (*Bucida buceras*), which he calls "torchuelo": a unique record and all the more surprising when one considers how many coffee trees and coffee shade trees in the Utuado region must have been infested at the time he was in Puerto Rico. The "guamá" (*Inga laurina*), and the "guaba" (*Inga vera*), both commonly used as shade trees for coffee in

Puerto Rico, are possibly most often and most heavily infested with the hormiguilla, but mango, orange, "pomarrosa" (*Eugenia jambos*), "jobillo" (*Spondias purpurea*), and "tulipán" or African tulip tree (*Spathodea campanulata*), present in the coffee groves, also serve as hosts. Colonies have been found in hollow twigs and empty burrows of the caterpillars of *Agathodes designalis* Gueneé in the shoots of the "bucare" (*Erythrina berteroana*) at Arecibo, and in crevices in the bark of *Erythrina poeppigiana* at Aibonito, by Dr. Luis F. Martorell. The trees of *Triplaris cumingiana* on the Station grounds at Río Piedras are infested, the ants living under the loose bark scales, but no other trees nearby are known to be infested. In the countries where this is a common endemic, because it so often harbors ants, it is called "hormiguero" (Costa Rica), "palo hormiguero" (Panama), or "bois fourmi" (French Guiana) and "formigueira" (Brasil), the species of ant harbored, however, in none of these countries being the hormiguilla of Puerto Rico. Under the loose bark scales of "tortugo amarillo" (*Sideroxylon foetidissimum*) at Isabela, large colonies exist. The twin jagüey tree (*Ficus stahlii*), close beside the road between Manatí and Ciales, is heavily infested, and because of ready availability, has been the scene of innumerable experiments in attempts to control. Possibly the most obvious direct injury to any tree caused by the hormiguilla is to be seen on some "pomarrosa" trees, besides the road between Lares and Adjuntas, of which all the new shoots are killed before they become as much as a foot long, but remain attached with dry, shriveled leaves. On coffee and guamá trees at an elevation of 2,700 feet in the Maricao Forest, infestations of hormiguilla were as serious as lower in the commercial groves. Experiments conducted by Mr. R. H. Van Zwaluwenburg, when he was Entomologist at the Mayagüez Station, in the use of shade trees for coffee which would not become infested with the hormiguilla, indicated that bananas do not harbor the ant, but can be used only for small trees as temporary shade. Every large tree suitable for coffee shade, eventually became infested.

Of natural enemies, the hormiguilla has very few, Dr. Alex. Wetmore finding these ants only in the stomachs of the woodpecker. The grass lizard, *Anolis pulchellus*, and all arboreal lizards eat the hormiguilla, which indeed constituted 12 per cent of the total food of *Anolis stratulus*. As many of these lizards were collected on or near trees infested with the ants, it is possible that the results are somewhat affected by this accident of collection. Yet to try to find the exceptional areas in the western end of the Island where coffee groves are not infested would also give a distorted picture of the normal food habits of these arboreal lizards.

Until the most recent past, extensive experiments in the use of more direct methods of chemical control have been only very partially success-

ful. The basis of all experiments has been an observation made in the coffee groves at Lares of the ants feeding on dead spiders and insects, and even on bird dung. The honeydew obtained from their mealybugs and soft scale insects is by no means a balanced diet, and they crave proteins. Bits of meat or cheese are soon covered with ants, and it was thought that it might be possible to kill them by poisoned meat baits. Of the numerous poisons tried, thallium acetate was the most successful, but altho Hamburg steak mixed with water-soluble compounds of thallium had no effect on the bark of the jagüey tree at Ciales, it proved to be very toxic to coffee and coffee shade trees. The fumes of cyanide mixed with meat overpower the ants so rapidly that they fall from the tree, and soon after recover, but when the meat is modeled into a little shelf, it becomes covered with their dead bodies. Unpoisoned meat placed over an open container for cyanide is even more attractive, but the containers fill with water, as well as with dead ants, and in a test run for a month with daily replacement of the bait, the number of ants on the tree showed no apparent diminution. All of these methods are moderately effective, but none is commercially practical.

As soon as adequate supplies of DDT were available after the end of World War II, preliminary experiments were made in spraying this new chemical on hormiguilla-infested trees. Small-scale preliminary tests showed that applied as a 5% solution in kerosene, it was very effective in killing the ants. The trunk of the jagüey tree at Ciales was completely cleared of hormiguilla at the first spraying, and none started to return for over six months. The upper, unsprayed part of the tree was still full of ants, however, but none even attempted to descend to the ground along their runways on the outside of the trunk. Testing 5% DDT in kerosene on mango and orange trees in coffee groves, all ants were killed on the parts of the tree sprayed, and none invaded these parts of the trees. When applications were made on coffee and coffee shade trees, the 5% DDT in kerosene was equally effective in killing the ants, but it proved toxic to the young leaves and shoots of the coffee trees. When DDT dust was used it had no apparent effect on the ants, and spraying with a water suspension of DDT, altho partially effective in killing the ants, and entirely non-toxic to the tenderest leaves and shoots, has only a very temporary effect in keeping the ants from returning to the sprayed areas.

Tests with a 1% water suspension of aldrin (Hyman 118) show that this newer chemical is as toxic as DDT to the ants, its residual effect lasts for months, and it is not injurious to even the tenderest foliage. Dilutions of one-half and one-quarter percent will kill hormiguilla, but the residual effect is quite temporary, and it is not to be recommended. Airplane application during the dry winter months to all hormiguilla-infested groves of 1%

aldrin should greatly aid in the rehabilitation of the local coffee industry by eliminating a most serious insect pest, not present in other coffee-producing countries.

SPHECOIDEA: Crabronidae

Ectemnius craesus (Lepeletier) is a little black and yellow wasp, first collected in Puerto Rico by Dr. Gundlach, who noted of his specimens: "Los ejemplares de Puerto Rico difieren en algo del tipo cubano—en el color de la pubescencia." Actually the pubescence is barely perceptible, the wasps appearing bright and shiny black, with yellow pronotum, yellow dorsal band posteriorly on the scutel and on the metanotum, one on the median and the post-terminal segments of the abdomen, and the legs yellow. Two adults emerged from a tunnel in a rotten log at Río Piedras, and one has been collected at Guayama. Mr. E. G. Smyth has specimens from Mona Island, but none has been found there since.

Ectemnius mayeri, described as a *Crabro* by Dr. Hermann Dewitz (1881–201) from specimens collected by Dr. Gundlach "en los contornos de Mayagüez," has not since been found.

Cerceris krugii, described by Dr. Hermann Dewitz (1881–201) and named for the German consul at Mayagüez, occurs, according to Dr. Gundlach "en varias localidades", but has not since been collected anywhere in Puerto Rico, altho Dr. Alex. Wetmore found the remains of a wasp identified as a species of *Cerceris* among the stomach contents of a Jamaican vireo.

Cerceris margaretella, included by Mr. S. A. Rohwer in his "Descriptions of New Species of Hymenoptera" (Proc. U. S. National Museum, **49** (2105): 205–249. Washington, D. C., July 16, 1915), the type material, three males collected by Dr. C. W. Hooker at Mayagüez, is close to Cresson's *Cerceris festiva* from Cuba, but may be distinguished by the "different colored antennae and the yellow propodeal enclosure." The Cuban species is "black, feebly punctured; face, collar, tegulae, spot beneath wings, scutellum, a longitudinal spot on each side of the metathorax, four anterior legs, basal two-thirds of hind tibiae and apex of the four basal segments of the abdomen, yellow."

Psen (Mimesa) modesta Rohwer (1915–244) is an endemic, entirely black wasp, except for pallid tarsi and silvery pile on some parts of the body, the "wings dusky hyaline, iridescent; veination dark brown." The types were three males from Mayagüez, "no collector given." It has not since been found in Puerto Rico. Malloch (1933) places it in the subgenus **Mimumesa.**

Trachypus gerstaeckeri Dewitz (1881–202), of which the type was collected by Dr. Gundlach at Mayagüez, has not since been found.

Nyssonidae

Nysson (Brachystegus) basirufus Rohwer (1915–247) is a black wasp with dense pubescence on the body, only the posterior legs rufous, described from a single female collected by Dr. C. W. Hooker at Mayaguez. It has not since been found.

Hoplisus (Hoplisoides) scitulus (Cresson) was the determination given by Mr. S. A. Rohwer to Mr. Thos. H. Jones of a wasp which he collected emerging from a tunnel in the sandy bank of the railroad to Trujillo Alto. This black wasp, extensively spotted with yellow, originally described from Cuba in the genus *Harpactus*, was first collected in Puerto Rico by Dr. Gundlach. It has since been intercepted on mulberry tree at Arecibo. It is characterized by "the large yellow spots on the matathorax."

A wasp collected on Mona Island by Prof. J. A. Ramos (1947–67) has been identified by Dr. H. K. Townes as a species of **Trypoxylon.**

Sphecidae (Larridae)

Prononyx thomae (F.) is a large, slender, black wasp, with elongate black petiole, bright chestnut-red gaster, with its face, top of pronotum and mesonotum laterally densely covered with light golden pubescence. Its color pattern almost exactly parallels that of the introduced changa parasite, *Larra americana* (Saussure), and when observations were being made on the dispersion of the latter in Puerto Rico, *Prononyx thomae* was often noted on the flowers of "botoncillo" (*Borreria verticillata*) in the regions to which *Larra* had not, at the time, penetrated: Fajardo, Luquillo, Mameyes, Laguna San José, Dorado, and all along the north coast close to the beach, to Quebradillas, Isabela and Aguada. It has repeatedly been collected on the airport of Mona Island, where it is possibly more abundant than anywhere in Puerto Rico. A dead adult was found in a salt-pool at Guánica, and interceptions have been made at Ponce, Santa Isabel and Salinas. A female carrying a grasshopper larger than herself was noted at Isabela. At Naguabo, one digging in a ditch in a cane field was observed to make a hole larger than herself in a few minutes. On the same scale, a man with tools would require the better part of a day to make as large a hole. This wasp is listed by Drs. Gundlach and Stahl, and Dr. Wetmore found it eaten by the kingbird.

Ammobia ichneumonea (Linn.), variety **auriflua** (Perty), under the names of *Sphex croesus* F. and *Sphex auriflua* Perty was listed from Puerto Rico by Drs. Gundlach and Stahl, and as a *Sceliphron* by Ashmead. It is one of the largest wasps to be found on the Island: black with long golden pubescence, the basal half of the gaster and the legs being bright yellowish brown. Altho at times found near the coast, it is much more characteristic of the higher mountains: in the Luquillo and Maricao Forests, and of the higher coffee groves, at Lares, Las Marías and Orocovis.

Ammobia singularis (F. Smith) is considerably smaller and more common along the coast, having been noted repeatedly on the flowers of *Borreria verticillata* and *Hyptis atrorubens* when determining the spread of *Larra americana* in the humid regions where the changa is abundant. It has been intercepted at Guánica and Salinas, and occurs on Mona Island. Mr. Thos. H. Jones at Río Piedras found a grasshopper, *Conocephalus fasciatum* DeG., in the burrow of this wasp. It was not listed by Drs. Gundlach or Stahl, the earliest record for Puerto Rico being in Mr. R. H. Van Zwaluwenburg's list (P. R. 93) as *Chlorion dubitata* Cresson. "From a study of the specimens from various localities" made by Miss Grace A. Sandhouse, "it is evident that these are conspecific, but the synonymy has not been published."

Sceliphron assimile Dahlbom (from Haiti). Three times natural size. (Drawn by F. Maximilien.)

Sceliphron caementarium (Drury) is the most "thread-waisted" and slender of the large mud-dauber wasps. It is apparently a recent introduction from continental America, as Drs. Stahl and Gundlach have no record of its occurrence here. Mostly black or very dark brown in color, with extremely long and slender legs and abdominal petiole, it was first noted in Puerto Rico on the walls of a house in Santurce in September 1924, by Mr. José I. Otero, who found its nests, made mostly of sand, 35mm. long and 12mm. wide, provisioned with at least three kinds of spiders. Subsequently, females have been found building nests, invariably provisioned with spiders, at Bayamón, at Manatí under a nearly horizontal coconut palm, and at Aibonito in the concavities of a big rock.

They have been intercepted at San Juan and on crotalaria flowers at Manatí, noted in 1937 at Villalba on a guava bush, and on corn plants at Mayagüez in the same year.

Tachysphex sp. was the identification by Miss Grace A. Sandhouse of a wasp intercepted at San Juan.

Dr. Gundlach listed five species of *Larrada* from Puerto Rico, and Drs. Stahl and Dewitz, four, or which two: **fuliginosa** Dahlberg and **luteipennis** Cresson have not since been found in Puerto Rico. Subsequently called *Notogonidea*, and at present **Motes,** these all black wasps, with short whitish pubescence or bloom, wings yellow or hyaline with iridescent reflections, no abdominal petiole, are characterized by a transverse ridge on the front below the anterior ocellus.

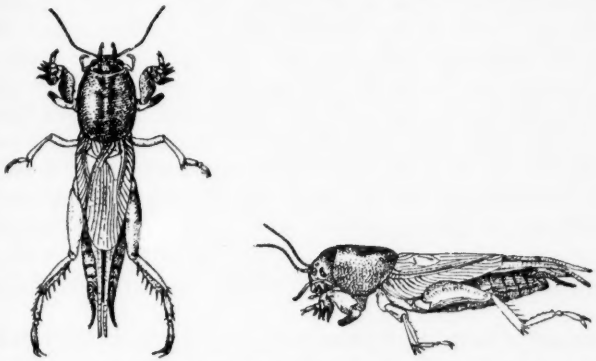
Motes ignipennis (Smith) is apparently the more common species, having been repeatedly noted on the flowers of "botoncillo" (*Borreria verticillata*) at numerous points along the north coast, and intercepted on crotalaria flowers at Barceloneta and Vega Baja. In cane fields it has been collected at Coloso and Guánica, and Mr. R. H. Van Zwaluwenburg lists it (P. R. 71) from Mayagüez. It was very abundant on the flowers of *Heliotropium indicum* at the airport on Vieques Island, and Dr. Luis F. Martorell noted it on "fresa" bushes (*Rubus rosaefolius*) in the mountains above Cayey.

Motes trifasciatus (Smith), listed as a *Larrada* by Ashmead from Puerto Rico as well as by Drs. Gundlach, Stahl, and Dewitz, has also been determined from specimens collected in fruitfly traps as *Leptolarra*. Interceptions have been made from flowers of grapefruit at Manatí and Naguabo. The specimens collected by Prof. J. A. Ramos on Mona Island were identified by Dr. H. K. Townes as "like" this species.

Mr. S. A. Rohwer identified as *Notogonidea* **vinulenta** (Cresson) the black wasps which Mr. E. G. Smyth collected on Mona Island in 1913, and Dr. H. K. Townes as "like" this species those which Prof. J. A. Ramos collected there more recently. It is listed as a *Larrada* by Dr. Gundlach from Puerto Rico, and has been intercepted on grapefruit flowers at Barceloneta.

Tachytes insularis Cresson, a plain black wasp with clear, transparent wings, extensive silvery bloom, especially on the legs, and a much hairier front, with no transverse ridge or raised inner margin of the eyes, was listed by Dr. Gundlach as "rara," but innumerable recent collections would indicate that it is only more wary: too swift of movement to be caught without a net. Miss Grace A. Sandhouse states (in correspondence) that "from a study of the specimens of the genus from Puerto Rico it appears that a single species is involved, and, according to the material in the collection, the name should be *insularis* Cr., rather than *argentipes*

Sm. However, the types would have to be seen to verify this." This black wasp has been noted in large numbers on the flowers of *Heliotropium indicum* on Vieques Island, and observed innumerable times on the flowers of "botoncillo" (*Borreria verticillata*) near the beach along the north coast of Puerto Rico. It has been intercepted on crotalaria flowers at Arecibo and Barceloneta, on mango flowers at Mayagüez and on young corn plants at Aguadilla. First collected on Mona Island in 1913 by Mr. E. G. Smyth, it has repeatedly been seen since on the ground at the airport. Noted resting on guava bushes at Sabana Grande, this appears to be its nearest approach to the xerophytic regions of Puerto Rico, but it also is not well adapted to a very humid environment, for it has been found by Mr. Ovidio García killed by an entomogenous fungus resting on the leaf of a forest



The Host of *Larra americana* (Saussure): the Puerto Rican Mole-Cricket or "Changa," *Scapteriscus vicinus* Scudder. One and one-half times natural size. (After Barrett.)

tree at Río Abajo Plantation, at an elevation of 1,200 feet above sea-level at Arecibo. This fungus was identified by Miss Vera K. Charles as *Cordyceps sphecocephala* (Klotzsch) Massee. It had produced a curved stipe growing out of the apex of the abdomen of the wasp, several time the length of the dead insect. At the end of the stipe was a pointed fruiting head.

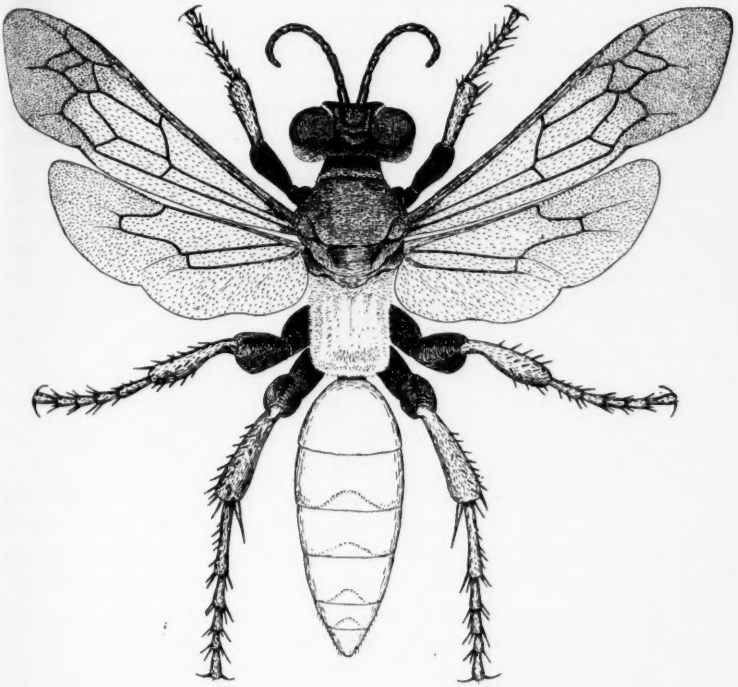
Dr. Francis X. Williams in recording his "Studies in Tropical Wasps—Their Hosts and Associates" (Entomological Series Bulletin No. 19, Hawaiian Sugar Planters' Association Experiment Station, pp. 179, fig. 16, pl. 33. Honolulu, January 1928), gave the first intimation of effective parasitization of the Puerto Rican changa. His beautifully accurate drawings (pl. V, p. 43) and extensive observations on the habits and abundance of this parasite at Belém, Pará do Brasil, greatly simplified the initiation of the project of "The Introduction into Puerto Rico of *Larra americana*

Saussure, a specific Parasite of the 'Changa' or Puerto Rican Mole-Cricket, *Scapteriscus vicinus* Scudder" (Jour. Agr. Univ. P. R., **22** (2): 193–218, fig. 4, ref. 16. San Juan, April 1938) in February 1936. What Dr. Williams probably never imagined was that the "Presence of Host Keeps Parasites alive in Captivity" (Science, **87** (2259): 352. New York, April 15, 1938), and that accompanying the live wasps with freshly parasitized changas, each in a separate can inside the container with the wasps, permitted 83.7% of the wasps to reach Puerto Rico alive and vigorous, as compared with a mortality of over nine-tenths of the wasps when they were sent from Belém unaccompanied by live hosts. The live changas, each bearing an egg of the parasite on the softest and most delicate part of the underside of its body, just behind the first pair of legs, were released, together with the live wasps, at six different points. "The Establishment in Puerto Rico of *Larra americana* Saussure" (Jour. Ec. Ent., **34** (1): 53-6, ref. 8. Menasha, April 1941) was already assured by January 1939 at two points: (1) to the south of Laguna San José, near Río Piedras, and (2) at Maleza Farm between Isabela and Aguadilla, now Punta Borinquen Air Base of the U. S. Army. A third point of later establishment was near Laguna Tortuguero at Vega Baja, from which three localities it has spread by natural dispersion so that by 1946 its presence was definitely established from Mayagüez on the west coast, north to Aguada and Aguadilla, all along the north coast and around the northeastern corner of the Island and south to Humacao Playa and inland to the municipality of Humacao itself.

The female of **Larra americana** (Saussure) is a large black wasp with golden pubescence, no petiole but shining bright chestnut gaster, considerably exceeding in size and brilliance the comparatively small and dull male. In the Amazon region, the Guianas, Venezuela and in Puerto Rico, the adults frequent the flowers only of *Borreria verticillata* (L.) Meyer and *Hyptis atrorubens* Poit., the common name for both species in Puerto Rico being "botoncillo." At Belém, the females have a very definite daily cycle during the months before and after the rainy season, searching for changas early in the morning, and only frequenting flowers from 10 o'clock to midday, most abundantly just before the heavy daily rainfall which normally occurs shortly after noon. Rarely are they to be seen on flowers in the afternoon, and practically never on flowers when the sun is obscured by a cloud. In the brightest and most intense sunshine, they promptly observe the advance of the collector, and prove to be most difficult to catch, changing their position so that both eyes are towards the intruder, and taking flight at the first movement of the net. In Puerto Rico, they prove to be noticeably less wild, and, with a less definite daily cycle of rainfall, may be observed in the early afternoon, but only on the

same flowers which they frequent on the continent. So far as we know, the female wasps attack only *Scaptericus vicinus* Scudder, being obligate parasites on that one species: the Puerto Rican changa.

Changas may most readily be found when heavy rainfall has saturated the soil with water, forcing them to burrow close to the surface, and, at times, to run clumsily about on top of the soil, where they can be most readily pounced upon by the female wasp. "These Pará *Larra*," as observed by Dr. Williams (1928-47), "sting their victims in a systematic



Female of *Larra americana* (Saussure), about six times natural size. (Drawn by F. Seín.)

manner: first, one or more stings are administered in the center between the third and second pair of legs, then between the second and first pair, and here perhaps most time is employed, and finally, beneath on the mouth parts or cheeks." As soon as the bluntly crescentic egg is laid, the wasp promptly ceases to be interested in the changa which she has just parasitized, which is usually able to stagger off, unless attacked meanwhile by

another wasp. In captivity and in nature, the wasps fight fiercely over possession of a changa, so that to obtain least stung mole-crickets with but a single parasite egg, it was customary to remove the changa with a single wasp from the general cage, and place them in a large glass vial until oviposition was completed. "Oviposition varied from one to three per day, and the intervals were usually considerable. One might conclude," continues Dr. Williams, "that not more than one or two ripe eggs are to be found at one time in her ovaries." The egg, pink at first, becomes somewhat swollen and dull grey in color as it approaches hatching, on the fourth or fifth day. The maggot grows with surprising rapidity, eventually sucking the changa skin clean and dry before starting to secrete the dark viscous liquid which sticks grains of sand together to form a cocoon within which to pupate. Dr. Williams found that "the entire life cycle in some cases occupied as much as 65 days, although about 50 days is perhaps a better average. All the wasps issued in the morning and mated readily in captivity." In Puerto Rico, *Larra* appears to have become well adjusted to local conditions, and at times is the most abundant large Hymenopterous insect to be seen on botoncillo flowers, not even excepting honey bees. To date, it has spread mostly along the coast, in most favorable environments, and it remains to be seen if it will eventually disperse into the tobacco-producing regions of the interior where its activities will be economically most valuable.

Bembicidae

Bembix ciliata Fabricius, which Dr. Gundlach noted "vive en las playas," was also collected by Dr. Stahl and is listed by Dewitz and Ashmead. In more recent times, specimens thus identified by Mr. S. A. Rohwer were found by Mr. Thos. H. Jones quite abundant in a very dry pasture at Hda. Florida, Santa Isabel, and a single subsequent collection has been made at Guayanilla. "The exact identity of Fabricius' *ciliata* is unknown."

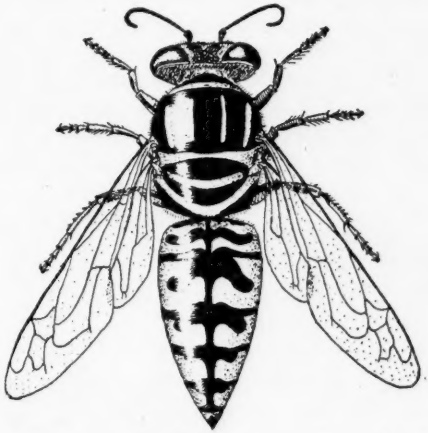
Bembix muscicapa Handlirsch was the identification by Miss Grace A. Sandhouse of the wasps intercepted by Mr. R. G. Oakley on flowers at Salinas: the only record of this species from Puerto Rico.

Bembex regularis Cresson, presumably a MS name, was listed by Dr. Stahl.

A single specimen of what Miss Grace A. Sandhouse identified as **Bicyrtes spinosa** (F.) was collected by Dr. Luis F. Martorell on the weeds at Sardinero Beach, Mona Island.

Stictia signata (L.), listed by Ledru from Puerto Rico in 1797 as a *Bembex*, and subsequently by Drs. Stahl and Dewitz, is twice as large as any of the above, and much more abundant. As *Monedula*, Dr. Gundlach noted it as "común en terrenos arenosos, cavando allí hoyos con mucha prontitud. Apenas se le ve posarse, pues vuela prontamente como juge-

teando un individuo con otro" Dr. Stuart T. Danforth, in describing the environment of the "Birds of the Cartagena Lagoon" (Jour. Dept. Agr. P. R., **10** (1): 1–136, fig. 45, ref. 41. San Juan, January 1926), tells of these wasps catching flies, and living in holes in the clayey soil around the margin of the lagoon. He had specimens from Cartagena Lagoon, and also from Yauco, Juncos and Mayagüez, for this wasp is locally abundant all around the coast of Puerto Rico, as well as on Mona Island. Dr. Luis F. Martorell noted it at Playa de Pájaros, Uvero, Rancho Grande, Sardinero and in the forest of the interior of Mona Island. Presumably catching flies, he records it "flying over cow dung, and over rotten papaya fruits and over food in putrefaction, and, at times, very annoying to people, sometimes two or three of these wasps buzzing about a person."



Stictia signata (L.), three times natural size. (Drawn by F. Maximilien.)

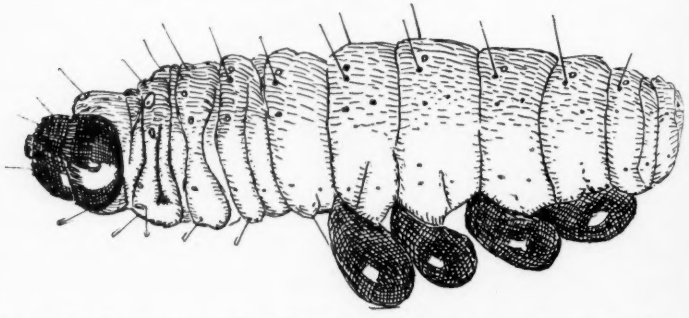
To provision their nests in the soil, usually sandy, where their young are reared, they catch flies of all kinds. Often this means house flies, attracted to molasses, but they also have been noted bothering horses which were being bitten by the Tabanid flies, *Chrysops variegata* (DeGeer), being much more disturbing to the horses than the flies that were sucking their blood. The wasps also come to flowers, having been intercepted on crotalaria flowers at Arecibo and on "icaco" (*Chrysobalanus icaco*) flowers at Dorado, but they rarely come to those of botoncillo, despite the abundance of this weed in the sandy areas frequented by the wasps.

Microbembex monodonta (Say) is a much smaller species with an extensive continental distribution, but in Puerto Rico found mostly in the western end of the Island. It has been collected on botoncillo blossoms at Vega Baja, and has repeatedly been intercepted on sandy beaches near

San Juan and in a pepper field at Loíza. "It is 8–14 mm. long," according to Dr. E. O. Essig (1926-876), "black, the abdomen wholly yellow or with 1 to 5 black bands, the wings often infumated. It nests in sandy places and makes a single burrow which is provisioned with dead insects which are gathered on the sands, and does not follow the general practise of capturing live prey and paralyzing it in order to provide a fresh supply of food for the young. The nests are not provisioned until the eggs hatch, after which new stores are brought over a period of several days."

VESPOIDEA: Bethylidae

Goniozus platynotae Ashmead, a small, shining black wasp, 3.0 mm. long, with mandibles, antennae and legs honey-yellow in color, found as far north as New England, has been identified by Mr. C. F. W. Muesebeck as a parasite reared by Dr. Luis F. Martorell from caterpillars of the bucare stem-borer, *Agathodes designalis* Guenée, at Cayey. The parasitic grubs, when fully-grown, spin four or five cocoons together in a fold in the leaf. This wasp may be more abundant than is suspected, for adults have been intercepted at Guayama.



Larvae of *Parasierola* prob. *cellularis* (Say), feeding on caterpillar of *Fundella pellucens* Zeller. Fifteen times natural size. (Drawn by G. N. Wolcott.)

Parasierola nigrifemur (Ashmead), as determined by Mr. C. F. W. Muesebeck, has been reared from a caterpillar of *Pyroderces stigmatophora* (Walsingham), at Isabela. Five opalescent rounded maggots on one host in an old cotton boll attained full growth in a few days, and spun brownish cocoons underneath the empty caterpillar skin, from which the black, ant-like adults emerged a week later. This, or a very similar species, has been reared from pink bollworm larvae at Mayagüez, and also from larvae of *Kearfootia*. Among the dead insects collected from the cotton ginnery at Isabela, after its interior had been sprayed with 5% DDT in kerosene, was one specimen of this genus. The continental species, **Parasierola cellularis** (Say), or on every near, according to Mr. A. B. Gahan, was reared

from the larva of *Fundella pellucens* Zeller, one of the lima bean pod-borers, at Isabela.

Dr. Donald De Leon reared from the stems of *Derris eliptica* infested with Cerambycid or Bostrychid larvae at Río Piedras, a wasp which was identified as a species of **Plastanoxus.**

Dryinidae

"A Dryinid Parasite attacking *Baldulus maidis* in Puerto Rico" (Jour. Agr. Univ. P. R., **22** (4): 497. Rio Piedras, October 1938) which Dr. Kenneth A. Bartlett found at Mayaguez, was identified as a new species of **Gonatopus** by Mr. C. F. W. Muesebeck. The same identification by Mr. Muesebeck was of wasps reared from cocoons on cane leaves at Río Piedras by Mr. Thos. H. Jones in 1912, and most recently Prof. J. A. Ramos (1947-64) found a **Gonatopus** on Mona Island.

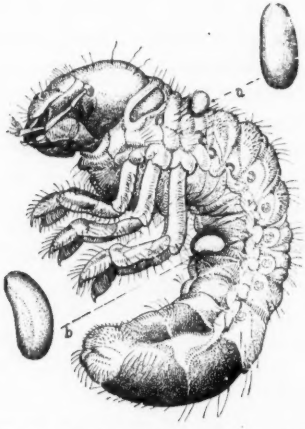
Fish scale-like cocoons on grapefruit leaves accompanying heavy infestations of *Ormenis infuscata* Stål at Manatí in 1933 had emerged from them three species of wasps, one of which Mr. A. B. Gahan identified as a new species of *Spilochalcis*, but the one which Mr. C. F. W. Muesebeck thought to be an undoubted primary parasite on the Fulgorid he identified as "? gen. nov., sp. nov. Lestrodryinini, subfamily Anteoninae."

Scoliidae: White Grub Parasites

Before the giant Surinam toad, *Bufo marinus* (L.), had been introduced into Puerto Rico, and white grubs were the major pest of every agricultural crop, the habits of the endemic Scoliid wasps were most intensively studied because the female adults lay their eggs on white grubs and their larvae are parasitic on them. The economic importance of these wasps is shown by the normal scarcity of their hosts where they are abundant, and conversely the enormous abundance of injurious species of white grubs in Puerto Rico which are attacked by no common endemic Scoliid. Indeed, the importation of the Surinam toad was so overwhelmingly successful mainly because it had practically no competition (except its own ever increasing numbers) for what seemed to be an inexhaustible supply of food.

Myzine haemorrhoidalis (Fabricius), listed from Puerto Rico by Drs. Gundlach, Stahl, Dewitz and Aldrich as *M. sexcincta* Fabricius, and by Mr. D. L. Van Dine as *Elis sexcincta* Fabricius, is probably the most abundant Scoliid wasp to be found in Puerto Rico. The female is black, marked with yellow, the yellow bands of the abdomen being interrupted so that a continuous black stripe extends down the center of her back. The males are very slender, marked and banded with yellow, and sometimes cluster in large compact masses on low vegetation, such clusters containing not a single female. In an account of the "Insect Parasite Introductions into Porto Rico" (Jour. Dept. Agr. P. R., **6** (1): 5–20, fig. 7. San Juan, October 1922), the host is given as "*Lachnosterna* (*Phytalus*) *insularis* Smyth."

This is *Phytalus* (now *Clemora*) *apicalis* Blanchard. Both sexes of the wasp have been reared from cocoons collected in a plowed field between Palo Seco and Pt. Salinas, February 24th, 1922, in the outer threads of which were entangled the shriveled remains of small white grubs, identified on the basis of their skulls and mandibles as being the third instar larvae of this small May beetle. Such grubs, when alive and healthy, weigh from three to six times as much as do the wasps parasitizing them. Mr. Harold E. Box, at the time that he was employed by Central Aguirre, in his account of "Porto Rican Cane-Grubs and Their Natural Enemies" (Jour. Dept. Agr. P. R., **9** (4): 291–356, fig. 21, ref. 15. San Juan, October 1925), narrates of this wasp how "during February and March, 1200



A continental White Grub, showing position of parasitic Scoliid eggs: *a*, *Tiphia punctata* Rob., *b*, *T. transversa* Say, and eggs much enlarged. (After Davis.)

females were collected, and released in another hacienda where *Phytalus* grubs were known to be common in certain fields, but where hitherto no signs of the presence of the parasite had been noted, with the result that on the 3rd of April they had accounted for 7% of the *Phytalus* grubs, while three weeks later, parasitism had amounted to 26%. During late May and early June, the parasites were more abundant in their new quarter than in the locality from which they had been taken."

The females of *Myzine haemorrhoidalis* are fond of honeydew, and have been noted obtaining it from *Aphis gossypii* Glover on cotton at Isabela, and from the soft green scale, *Coccus viridis* Greene, on grapefruit at Isabela and on "palo de muñeca" (*Rauwolfia tetraphylla*) at Aguadilla. Both males and females are often to be seen in the greatest abundance on the

common flowers of the sandy land along the beach, and are possibly attracted in greatest numbers to those of "botoncillo" (*Borreria verticillata*). The flowers of seagrape (*Coccoloba uvifera*) at Arecibo and of "ucar" (*Bucida buceras*) on Vieques Island have been noted swarming with these wasps. On Mona Island Dr. Luis F. Martorell noted them on the flowers of "abeyuelo" (*Colubrina ferruginosa*) and "corcho" (*Pisonia albida*), and at Santa Isabel on imported tamarisk trees. Apparently the wasps are almost equally abundant on the north and south coasts of Puerto Rico. Their presence on Mona Island presumably indicates that they there parasitize the endemic small May beetle, *Abcrana monana* (Moser), and their presence on Vieques indicates that *Clemora apicalis* (Blanchard) is present there.

Only the flycatcher is noted by Dr. Wetmore as having eaten this wasp. Females have been found in the stomach of the lizard *Anolis cristatellus*. Much more serious in reducing their numbers is parasitism by the common Bombyliid fly, *Anthrax gorgon* F., reared from a sixth of the cocoons found between Palo Seco and Pt. Salinas.

Myzine ephippium (Fabricius) has males and females differing so greatly in general appearance that each has subsequently been redescribed: the slender male as *Myzine apicalis* by Mr. Cresson (1865–117) "black; length $5\frac{3}{4}$ lines; legs and apical margins of abdominal segments, yellow or ferruginous"; the plump female as *Elis xanthonotus* by Mr. S. A. Rohwer (1915–234) "length 14 mm., readily distinguished by its black color and yellow mesoscutum," which in life and usually even in museum specimens is a bright chestnut red, the type specimen having been collected at Río Piedras by Mr. Thos. H. Jones. Dr. Gundlach, listing the female as "rara," and the male, under Cresson's name, as "común," adds "acaso sea la misma que *M. ephippium* Fabr." This would seem the reverse of the present status of the sexes, for the females are often observed on the flowers of "botoncillo" (*Borreria verticillata*), and the males less often. Mr. E G. Smyth's version is that "the female wasps occur on the flowers of *Hyptis atrorubens*; the males on *Mitracarpus portoricensis*" (=*Borreria verticillata*). Females have been noted on the flowers of *Cordia corymbosa* at Mayagüez, and on the flowers of the yellow caltrop (*Tribulus cistoides*) at Puerta de Tierra, and both sexes intercepted in grapefruit groves at Dorado and Garrochales.

"This is one of the Scoliids whose distribution in Porto Rico, so far as known, is confined to the north of the Island," according to Mr. Harold E. Box (1925-336), but it remained for another English Entomologist, Mr. Walter F. Jepson, working with headquarters at Treasure Island, Cidra, in his "Report on the Search for Parasites for *Phytalus smithi* Arr." (pp. 66, Port-Louis, Mauritius, 1936) to most exhaustively study its habits. "Both males and females frequented (the flowers of *Borreria verticillata*) to

the exclusion of all others. As soon as the sun temperature approached 80°, i.e. about 9:30 a.m., the females of this species could be found crawling from flower to flower, and making short flights to nearby plants. Within a few minutes of the sun becoming obscured, not a specimen could be collected, and no emergence took place on rainy days. By 1:30 p m. all females had disappeared, and males could be found congregating round the flower heads. The females lived in captivity, with average care, for a month or more; two specimens were kept for over 60 days." Mr. Jepson induced oviposition on the third instar grubs of *Lachnosterna* (now *Cnemarachis*) *portoricensis*, *L. vandinei* and *L. citri*, indicating that this is one of the most important of the natural endemic enemies of white grubs in the more humid parts of the Island. "The egg is placed ventrally on the permanently paralyzed host, with its long axis parallel to that of the body of the grub. (After two or three days) the larva hatches and feeds (for eight to twelve days) with its head towards that of the host. The cocoon is very tough and consists of more than twenty separable layers of threads, the outer one of which does not surround the cocoon like fluff, as in the case of the genus *Campsomeris*." Wasps emerge from the cocoons in from 75 to 87 days, making the total period for the immature stages approximately three months.

Dr. Wetmore reports this wasp eaten by the kingbird, but it was not found eaten by lizards or the imported toad. No cocoon has been found in nature, consequently nothing is known of possible parasitism by a Bombyliid fly, but it may be presumed that such parasitism does occur, otherwise this wasp, with such an abundance of hosts for the larval stage, should be much more common.

Campsomeris atrata (F.), the largest of all neotropical Scoliid wasps, and possibly the largest wasp in Puerto Rico, is entirely black except for dark orange and smoky-tipped wings. Listed by Ashmead, and as a *Scolia* by Drs. Stahl and Dewitz, Dr. Gundlach notes "muy común; su vuelo es lento y con ruido visita las flores." This refers to a time when a sparsely settled Puerto Rico was still being cleared of forests from the coastal lowlands, and rotten stumps and the roots of the trees in the soil offered abundant nourishment for the smaller endemic rhinoceros beetle, *Strataegus barbigerus* Chapin, and its grubs, which are the host of the parasitic stage of this wasp. Suggested by the relative size of wasp and grub, this was proved by Mr. Harold E. Box (1925–339), who collected wasp adults in Hispaniola and brought them alive to Puerto Rico, where he was able to induce them to oviposit on rhinoceros grubs taken from the cane fields of Central Aguirre. All the recent records of this wasp are from southwestern Puerto Rico: Aguirre, Ponce, Adjuntas, Lares, Utuado and Mayagüez. But on Mona Island, where *Strataegus barbigerus* is still abundant, Dr.

Luis F. Martorell, in March 1940, found the wasps in considerable numbers: females obtaining nectar from the flowers of such trees as were in flower at that time, mostly "angela" (*Moringa oleifera*), and to a lesser extent "corcho" (*Pisonia albida*) and "abeyuelo" (*Colubrina ferruginosa*).

Campsomeris dorsata (F.), a somewhat smaller wasp, which Dr. Gundlach found "rara," at the present time is abundant in all coastal Puerto Rico. Its larvae are parasitic on the grubs of *Ligyrus cuniculus* (Fabricius), which live on decaying vegetation and cane trash and dead stools in sandy land. Its large, stout-bodied females, black except for two broad, bright chestnut patches on the second and third abdominal segments, are often seen on the flowers of "botoncillo" (*Borreria verticillata*) along the north coast, but are possibly most abundant on those of the yellow caltrop (*Tribulus cistoides*) at Puerta de Tierra and along the Condado beach in the middle of the morning. On the south coast, the flowers of the wild "margarita" or shepherd's needles (*Bidens pilosa*), of "malva de caballo" (*Malachra alceifolia*) and of "abrojo" (*Kallstroemia maxima*) are frequented. Later in the day, the more slender males, with four light yellow abdominal bands, visit the same flowers which the females had monopolized in the morning, and are often present in considerably greater abundance. Over bare ground the males may fly rapidly backwards and forwards, and at dusk may be found gathered in clusters, many being suspended only by their mandibles. This gregarious habit was observed many times by Mr. Jepson (1936–28): "when one male alighted on a plant, it was joined by others coming from all directions. As many as two or three hundred were seen at one time." Dr. Luis F. Martorell noted males in great abundance flying over the sandy soil of a coconut nursery on Mona Island, and subsequently both sexes on the flowers of "angela and "abeyuelo," or resting on the foliage of the introduced beefwood (*Casuarina equisetifolia*).

Mr. H. Bourne, the cane technologist from Barbados for Central Guánica, was possibly the first to record the normal parasitism of the grubs of the wasp on those of *Ligyrus cuniculus*, at that time called *Ligyrus tumulosus* Burmeister. On June 20th, 1913, at Hda. Santa Rita, "when I was getting these grubs, I found 28 cocoons of a wasp, very probably the black one with the two reddish bands across the abdomen, because while digging, two flew out. This wasp is commonly seen in the callejones and cane fields. I also found one grub with a medium-sized larva attached to it, and one with the egg of the wasp freshly laid on its body."

Despite the looseness of the brownish silk forming the outer layer of the cocoon, the layer just beneath the outer network has a decided luster, and the cocoon as a whole is decidedly tough. Those which Mr. Jepson noted as "very fragile" were formed by wasp maggots which had developed on unnatural hosts in the laboratory, and were not at all typical. Of the

adults which he took with him to Mauritius, eleven "traveled for 53 days and then several lived over 40 days after arrival."

The most potent limiting factor for *Campsomeris dorsata* would appear to be scarcity of host grubs. Observations on "The Present Status of White Grub Parasites in Puerto Rico" (Jour. Agr. Univ. P. R., **18** (3): 436–441, fig. 2, ref. 6. Río Piedras, July 1934), some years after Messrs. Box and Jepson had found the wasps so "very abundant" on the south coast, showed the wasp comparatively scarce after the Surinam toad, *Bufo marinus* (L.), had been introduced into Puerto Rico and had become numerous. Mrs. Raquel Dexter discovered, moreover, that not only is the food of the larval stage of this wasp eaten by the toad, but also the male adults of the wasp itself, eight toads having eaten seventy males. Presumably the females move too rapidly to be caught by the toad, but the males may be easily caught when clustered on low vegetation for the night. As the males are greatly in excess of the females in numbers, having some of them eaten by toads does not greatly affect the status of the wasp. No wasps of either sex were found eaten by lizards, but Dr. Wetmore found them eaten by the kingbird, petchary and mockingbird.

Despite the apparently great difference in size of the sexes of *Campsomeris dorsata* there is little difference in their air-dry weight: the males 0.039 gr., the females 0.046 gr. This is only a sixth or a seventh of that of the air-dry weight of fully grown grubs of *Ligyrus cuniculus*: 0.28 gr. Obviously, the wasp maggots are very efficient in transforming beetle grub into wasp, for from the gross weight of the grub must be subtracted its alimentary contents, which is unavailable as food, and also its heavily chitinized jaws, skull and legs, for only the liquid parts of its body can be assimilated by the wasp maggot. Furthermore, in transforming from maggot to adult there is the loss which goes into the formation of the silken cocoon, together with minor one of its larval and pupal skins, all of which must be elaborated out of a single white grub, the only source of food during all the immature stages of the wasp.

Campsomeris tricincta (F.), of which *C. pyrura* Rohwer (1915–235), the type from Mayagüez, is a synonym, has a coarse golden-reddish pubescence on its body and legs, the hairs being especially noticeable on the terminal segments of the abdomen. It was listed by Drs. Stahl and Gundlach as a *Scolia*, and also by Ashmead, without comment as to its abundance. Altho specimens have been collected at Mayagüez and Ponce, or more likely in the mountains behind those cities, most collections have been made at higher elevations: at Adjuntas, Comerío, Cidra, and especially in the Luquillo Mountains, most recently on the flowers of *Clibadium erosum* on El Yunque. Mr. Harold E. Box records it from Mona Island, as well as from Hispaniola. From a female collected on a guava bush Mr. Walter F. Jepson was able to induce oviposition on third instar grubs

of *Lachnosterna portoricensis*. Because of its scarcity, however, he concluded that "the economic status of this species is obviously of no importance."

Campsomeris trifasciata (F.), of similar large size, but lacking the reddish pubescence of *C. tricincta*, with broader and yellower bands on the three anterior abdominal segments, was noted as "común" by Dr. Gundlach, and is listed by Drs. Dewitz and Stahl. Dr. Gundlach's observation as to its abundance is still true, in recent years having been seen in large numbers on the flowers of *Borreria verticillata* and *Hyptis atrorubens* all along the north coast and especially at Yabucoa. At Aguadilla it frequented the flowers of "malvavisco" (*Waltheria americana*), and at Manatí those of *Melanthera confusa*, and has been intercepted on roses and in grapefruit groves at Bayamón, and on crotalaria flowers at Pueblo Viejo. Mr. Jepson found it "common at Cidra, Isabela and Santa Isabel" frequenting many kinds of flowers, and was so easily able to induce females to oviposit on third instar grubs of *Lachnosterna portoricensis* as to suggest this as being the normal host in nature. Dr. Wetmore found that the wasps are eaten by the kingbird and the petchary.

Campsomeris maculata (Drury), listed by Mr. W. H. Ashmead in his "Report on the Aculeate Hymenoptera—of the West Indies," (London, 1900), from Puerto Rico, has not since been collected. According to Mr. S. A. Rower, *Campsomeris druryii* Cockerell is a synonym.

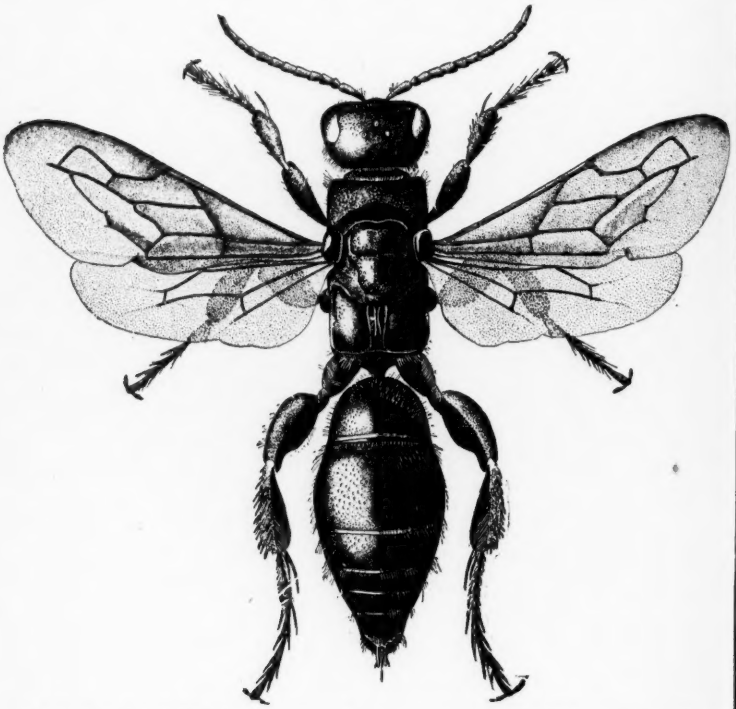
Campsomeris hyalina (Lepeletier), introduced from Venezuela by Mr. Harold E. Box and Mr. Luis A. Catoni, was shortly thereafter collected at Aguirre once, but not subsequently.

Scolia plumipes Drury, listed by Dr. Gundlach as "rara," of which Dr. Stahl claimed to have specimens, is a continental species not found in Puerto Rico.

Tiphia argentipes Cresson, noted by Dr. Gundlach as abundant in Puerto Rico, and listed by Drs. Stahl, Dewitz and Ashmead, is no longer abundant, and so few specimens of these all black wasps have been collected in recent years that it is impossible to be certain of the specific identity of the endemic Puerto Rican form. Mr. E. H. Barrow collected three rather small males on August 16th, 1921 at Hda. Santa Rita, Guánica, feeding on the secretions of a scale, *Pulvinaria psidii* Maskell, on "palo de muñeca" (*Rauwolfia tetraphylla*), and a few weeks later, another small male on the same small tree, and early the next year, one on a cotton plant near Yauco. Subsequently, Dr. Donald De Leon found a single male on a mahogany tree in the Guánica Forest; all of these specimens from the Guánica region are in the U. S. National Museum at present. Small males have been collected at light at Río Piedras, and on sooty-mold blackened guava bushes at Coloso and San Sebastián, and a single small female on Guanajibo Beach near Mayagüez. Dozens of female wasps were ob-

served on guava bushes heavily infested with *Pseudococcus nipae* (Maskell) in the mountains above Villalba in April 1931, but the observer had no means of collecting them, or anything to put them into, and this unique opportunity of obtaining an abundance of material for study was missed.

In the original description of *Tiphia argentipes* from Cuba, Mr. Cresson makes no mention of a "deep preapical grove and prominent median trans-



Adult female of *Tiphia transversa* Say, a continental Scoliid wasp parasitic on white grubs, about six times natural size. (After Davis.)

verse carina" on the first tergite of the abdomen, which is so obvious and characteristic of *Tiphia hispaniolae* Wolcott, noted in the "Description and Biologic Notes on a *Tiphia* from Haiti" (Jour. Agr. Univ. P. R., 22 (2): 189–92. Río Piedras, April 1938), and Miss Grace E. Sandhouse states that it does not occur on the Puerto Rican males in the U. S. National Museum. The males in the collection at Río Piedras are no larger than the smallest ones from Haiti, and the small female from Mayagüez is as

large as the smallest females from Kenscoff, but in all the transverse carina is much less noticeable, or absent. Thus, until Cresson's type can be compared with material from the other West Indies, one may tentatively use the name of the Cuban species for that found in Puerto Rico, altho it is presumably incorrect.

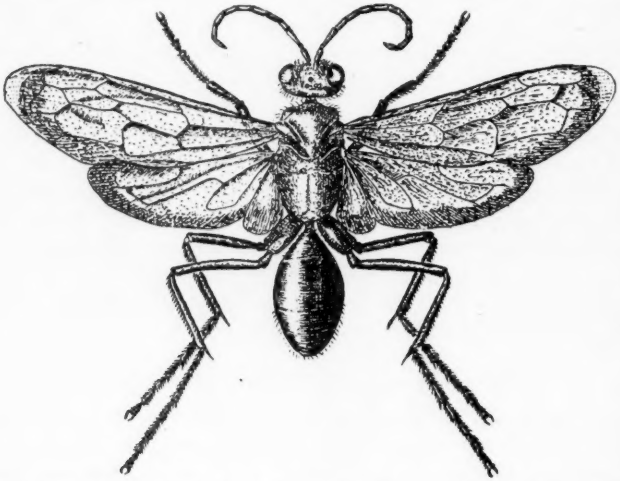
In late November and early December of 1946, collections of females of *Tiphia hispaniolae* Wolcott were made at Kenscoff and sent by airplane from Port-au-Prince to San Juan, some of which were released at Río Piedras or Isabela within less than 24 hours after collection in Haiti; the total mortality of the wasps en route being less than six per cent. In Hispaniola, the presence of white grubs in cultivated land, such as cane fields or pineapple plantations, is so exceptional as to indicate almost perfect natural control, presumably due in large part to the abundance of the endemic *Tiphia*. It was in the hope that this wasp might become established in Puerto Rico, and exert a similar effective control of white grubs, that its introduction was attempted. "Collecting Parasites of White Grubs for Puerto Rico: Then and Now" (Jour. Ec. Ent., **41** (5): 813. Menasha, October 1948) was indeed so successful at this first attempt that subsequent collections have been made in January and December 1947, December 1948 and March 1949, in an attempt to synchronize obtaining the wasps in Haiti with the flowering of Queen Ann's lace or wild carrot (*Daucus carota* L.) in Puerto Rico, from the flowers of which they were taken in greatest numbers in Haiti.

Psammocharidae (Pompilidae): Tarantula-Hawks

Pepsis marginata Palisot de Beauvois was the Psammocharid wasp used by Dr. Alexander Petrunkevitch, eminent specialist in spiders from Yale University, in making his observations on "Tarantula versus Tarantula-Hawk: a Study in Instinct" (Jour. Expt. Zool., **45** (2): 367–93, pl. 2. July 5, 1926) while exchange professor at the University of Puerto Rico. The hairy spider serving as host was *Cyrtopholis portoricae* Chambers. The wasp is the largest of the tarantula hawks occurring in Puerto Rico, but not the most brilliant, its legs and body being velvety black, its abdomen black with blue reflections in certain lights, its orange-yellow wings, except in front being duskily margined. The antennae of the males are curled; those of the females merely slightly curved. Listed by Dr. Stahl under this name, it is possible that this is what Drs. Gundlach, Dewitz and Ashmead call *Pepsis heros* Dahlbom, the former noting it as "común, pero aún no observado en Cuba." It is present in all the more humid parts of Puerto Rico, recent collections having been made at Luquillo, Río Piedras and Mayagüez.

Pepsis formosa Say, listed by Dr. Gundlach as *Pepsis caerulia* L. in

synonymy with *P. speciosa* F., as "rara en Puerto Rico," and by Drs. Dewitz and Ashmead, of which specimens from Puerto Rico were subsequently identified by Mr. S. A. Rohwer as *Pepsis rubra* (Drury) and confirmed under this name by Prof. Nathan Banks, is, according to Dr. E. O. Essig (1926–883) "the commonest and largest species in Mexico, Texas, New Mexico, Arizona and Southern California, and ranges south into Brasil." In Puerto Rico it was found both by Dr. Alex. Wetmore and Dr. Stuart T. Danforth to have been eaten by the kingbird. The females are much larger than the males, having bright orange-red wings very narrowly duskily margined, while the wings of the males are entirely blue-



The Tarantula-Hawk *Pepsis formosa* Say, twice natural size. (Drawn by Fritz Maximilien.)

black except for a small and rather obscure orange patch on the front margin of the forewings. They are so different in appearance, indeed, that the males have received the name of *Pepsis sanguigutta* Cresson, according to Prof. Nathan Banks. Both sexes have been observed associated on the same flowers obtaining nectar, specifically on the flowers of "cafeillo" (*Cascaria sylvestris*) at Río Piedras on May 18, 1941, and again at about the same time the next spring, when the little tree was again in flower. Mr. D. L. Van Dine collected both sexes "flying among weeds over a sandy knoll along the sea-shore between a field of cane" and the Caribbean at Hda. Florida, Santa Isabel on April 24th, 1913. At Hda. Teresa, Aguirre on February 16th, 1916, males were noted in abundance on the sticky

capsule vine, *Commicarpus scandens*. Prof. J. A. Ramos found males very abundant on Caja de Muertos Island, off the coast near Ponce, and some females. Females quite often frequent the flowers of "botoncillo" (*Borreria verticillata*), having been recorded at Pt. Cangrejos and at Aguadilla, and collections have been made in cane fields, or in flight, at Yabucoa, Naguabo, Luquillo and Mayagüez. Judging by the size of the females it may be presumed that the normal host for the immature stages is the same large tarantula attacked by the less brilliant *Pepsis marginata*.

Pepsis ruficornis (F.), a considerably smaller, entirely blue-black wasp, except for bright orange-red antennae, listed by Drs. Gundlach, Stahl, Dewitz and Ashmead, has been repeatedly collected since in all parts of the Island, from cane fields on the coast to the highest mountains. It is possibly more abundant, and certainly more characteristic, however, of the higher elevations. Even in the depths of virgin forests, as at Maricao, and in abandoned coffee groves, as at Indiera, it is noticeable because of its nervously vibrating bright chestnut antennae, in constant motion as it explores the soggy ground in search of its prey. No observation has been made as to the species of spider which it may attack, but even the largest females seem much too small to tackle fully-grown tarantulas.

Cryptocheilus ignipennis (Cresson), of which *C. flammipennis* (Smith) is a synonym, is a small blue-black wasp with bright chestnut antennae, dusky at the apex. Dr. Gundlach notes it, with synonymy, as "rara," and it is listed also by Drs. Dewitz and Ashmead. If one may judge by recent collections at Luquillo, Río Piedras, Bayamón, Cayey, Florida and Utuado, it can hardly be considered rare at present. Prof. J. A. Ramos (1947–68) found it on Mona Island.

Notiochares cubensis Cresson, as determined by Prof. Nathan Banks, is as entirely black or blue-black wasp of equal size. Listed as a *Pompilus* with *Pompilus anceps* Cresson in synonymy by Drs. Gundlach, Stahl and Ashmead, it was subsequently determined by Mr. S. A. Rohwer as *Pompiloides propinquus* Fox. It occurs in all parts of Puerto Rico, and has been found on the flowers of *Heliotropium indicum* on the Island of Vieques. In a cane field at Coloso, a female was noted carrying a legless spider, unidentified as to species.

Dr. Gundlach notes as "rara" the **Pompilus cressoni** described from Puerto Rico by Dr. Hermann Dewitz (1881-203), and also lists **P. coruscus** Smith, **P. flavus** Cresson, and **Pompilus ferrugineus** Dahlbom, none of which has since been found in Puerto Rico.

What Dr. Gundlach collected at Quebradillas and lists under the name *Pompilus fulgidus* Cresson, has been re-determined by Prof. Nathan Banks from fresh specimens collected from the Mayagüez region as an **Anoplius.**

Of the other wasps listed by Dr. Gundlach under the genus *Pompilus*,

the "rara" **flavopictus** Smith, and the **mundus** Cresson (= *concinnus* Cresson) are now considered to belong to the genus **Batazonus.**

Batazonus hookeri, described by Mr. S. A. Rohwer (1915–237) from from specimens collected at Mayagüez, has since been found at Ponce, and on flowers of coriander at Isabela seed farm.

Batazonus mundiformis Rohwer, as determined by Miss Grace Sandhouse, was intercepted on *Commelina* at Pueblo Viejo, and another wasp intercepted at Loíza Aldea was identified by her as a species of **Episyron.**

Pseudagenia bella (Cresson), a small black wasp with clear wings, has been reared from mud nests in the leaves of *Inga vera* at Cayey. Presumably they had been provisioned with spiders, as Dr. Donald De Leon observed a female chasing spiders among the leaves of a mahogany tree at Villalba. Dr. Gundlach collected this wasp at Mayagüez, and it is listed by Drs. Dewitz and Ashmead as a *Pompilus*, latter collections having been made at Mayagüez by Mr. R. H. Van Zwaluwenburg.

Eumenidae

The enlarged pedicel of the abdomen of **Zethus rufinodus** (Latreille) is bright chestnut red, as are also the legs, but the apex of the pedicel is yellow, as are markings on the thorax; the head and gaster are black. Dr. Gundlach thought this wasp rare in Puerto Rico, and it may have been at the time when he was here, but it was found at Mayagüez by Mr. R. H. Van Zwaluwenburg, and since collected on mango blossoms there, and on the flowers of *Borreria verticillata* at Joyuda beach. It is common all along the north coast, frequenting flowers of both kinds of botoncillo, and has been noted even in the mountains, at Lares and at Adjuntas. It is very abundant on Mona Island, specifically noted on flowers of *Lantana camara* and on tender leaves of *Coccoloba laurifolia*. At Laguna Tortuguero, a fence post of West Indian birch or "almácigo" (*Bursera simaruba*) was so heavily infested by these wood-boring wasps that constant replacement was necessary. One almácigo post, alive and with buds starting from lower down, was attacked by the wasps, which made so many and such deep longitudinal tunnels in the exposed upper end that it no longer served to hold the staple, being merely a thin shell of birch bark over a crumbling mass of much tunneled wood and the immature stages of the wasp. No mud is used with which to line the tunnels. From the character of the debris, no indication as to the food of the larvae could be surmised.

Eumenes ornatus Saussure, of which recent determinations have been made as "var. *abdominalis* Drury," and as "*Eumenes abdominalis* Drury, var. *ornatus* Saussure," is listed by Dr. Gundlach as "rara," but collections were made by Dr. Stahl, and by Mr. R. H. Van Zwaluwenburg at Mayagüez. The present College (AMC) collection contains several dozen speci-

mens, mostly from the western end of the Island. This mud potter wasp, occurs, however, in all parts of Puerto Rico, the most humid and elevated as well the most xerophytic. Collections have been made on botoncillo flowers at Río Piedras, Loíza, Luquillo and Yabucoa, and presumably it also frequents other kinds of flowers The conspicuous apically expanded portion of the pedicel of the almost inch-long adult is possibly brightest yellow, but most of the gaster, all of the pronotum, the tegulae, scutellum, metanotum, the lower part of the face, and tibiae and tarsi are also yellow, or duller orange. At Isabela, its flattened spherical nests of mud were built on the needles of a casuarina tree to serve as provisions for the larva of the wasp, so beautifully fashioned with a flaring neck that one hesitated in breaking them open to determine with what they were stored.

Pachodynerus atratus (Fabricius), a plump, entirely black wasp with very dark wings, was listed by Drs. Gundlach and Dewitz as a *Rhynchium*. by Dr. Stahl as *Odynerus aethiops* Cresson MS, and more recent records are as a *Monobiella*. It commonly frequents the flowers of *Hyptis atrorubens* and of *Borreria verticillata* along the north coast, but also occurs in the mountains and on the south coast. Females have been observed entering the almost completed nest of the mud-dauber, *Sceliphron caementarium* (Drury), at Loíza, and on the rock cliff between Arecibo and Utuado, presumably indicating that it is parasitic on this species.

Pachodynerus nasidens (Latreille) has the tegulae and posterior margins of the pronotum and the segments of the abdomen dull yellow, wings lighter and yellowish, and a yellowish pubescence. Adults have been noted frequenting botoncillo flowers from Yabucoa to Isabela, and were intercepted on flowers of "roble" (*Tabebuia pallida*) at Bayamón and Vega Alta.

Pachodynerus tibialis (Saussure), not found in Puerto Rico, but on Mona Island, has bright yellow anterior margin of pronotum, tegulae, metanotum, posterior margins of two abdominal segments and most of the area of the tibiae. Mr. E. G. Smyth in 1913 made the earlier collections on Mona, and also in the following year accompanying the scientists from the American Museum of Natural History, but left no notes accompanying his specimens. Dr. Luis F. Martorell found the wasps abundant on the flowers of *Lantana camara* and of *Colubrina ferruginosa*.

Of **Odynerus bucuensis** Saussure, Dr. Gundlach reports: "He recibido esta especie últimamente del Dr. Stahl."

Ancistrocerus dejectus (Cresson) is a small, slender wasp, marked in dull red much as is *Pachodynerus tibialis* in bright yellow, and more deeply punctured. It was listed as an *Odynerus* by Drs. Gundlach, Stahl, Dewitz and Ashmead, and as a species of this genus is reported by Dr. Wetmore as eaten by the petchary, and by Dr. Danforth as eaten by the kingbird. Abundant at Mayagüez, elsewhere this wasp is not very common, the only

recent collections having been made at Loíza, Caguas, La Plata, Coamo, Maricao and Isabela. A large cluster of these wasps observed on an asparagus fern at Río Piedras, June 4, 1923, indicates that at times they may be quite numerous.

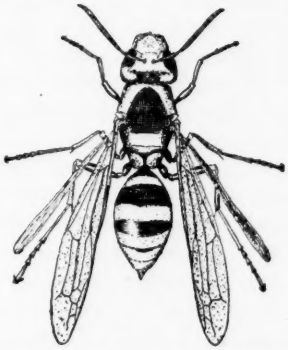
Monobia puertoricensis, described by Dr. J. C. Bequaert (Memorias de la Sociedad Cubana de Historia Natural, **15** (4): 375–8, fig. 1. Habana, Dec. 31, 1941) from a type collected by Dr. Luis F. Martorell at Cayey on the ground gathering clay, is a "medium-sized, slender species, 14 mm., fore wing 15.5 mm., ferruginous, slightly violaceous. Propodeum with teeth-like lateral angles, coarse transverse striation. Puncturation weak, except on clypeus."

Rygchium sp. is the determination by Dr. H. K. Townes of a single male wasp which Prof. J. A. Ramos (1947–68) collected on Mona Island.

Vespidae: Paper-nest Wasps

Polistes americanus Fabricius, the name given by Drs. Gundlach, Stahl, Dewitz and Ashmead for the common paper-nest building wasp of Puerto Rico, is again being used instead of *Polistes crinitus* Felton, as it was identified in 1913 by Mr. S. A. Rohwer. It occurs in all parts of Puerto Rico, and adults have been collected from the flowers of *Heliotropium indicum* on Vieques Island. On Mona Island adults have been noted on the tender leaves of *Coccoloba laurifolia*, and building nests, according to the observations of Dr. Luis F. Martorell, in mahogany and beefwood trees, as well as in seagrape and other endemic trees. The wasps frequent many flowers, having been noted on those of botoncillo at all localities, and more especially on those of the sticky-capsule vine, *Commicarpus scandens* L., at Guánica (May 1934), where they were more abundant than honey-bees, constituting 70 or 80% of all large Hymenoptera coming to these flowers. They are frequent visitors to partly-grown corn plants, collecting sap at punctures deserted by sucking insects, or stimulating its flow by biting the tissue, and also at times, as noted by Mr. W. K. Bailey (Mayagüez Station Report 1938–101) attacking and killing fat, juicy caterpillars of *Laphygma frugiperda* (A. & S.). On three separate occasions, they have been noted in cane fields attacking caterpillars of the Hesperiid, *Panoquina* (*Prenes*) *nero* F., and doubtless other kinds of caterpillars are eaten. One might hesitate about their status in the control of outbreaks of caterpillars, but at least they are a minor factor, and possibly in special cases may be of considerable importance. Enormous numbers of these wasps have been observed on El Yunque rock (April 5, 1939), so abundant that one could not even approach in safety. There appeared to be nothing in particular on the vegetation surrounding on which to feed: no caterpillars, no honeydew, and they kept in rapid motion, crawling and flying about on top of the

stunted trees and on the bare rock as tho in search of something that wasn't there. No nest was observed, and while the summit was dry at the time of observation it was not dry season for El Yunque, as heavy rains fell the day before and the day after. No other insect and no other species of *Polistes* was present. It is possible that air currents had carried these wasps up the mountain against their will, and continued to keep and concentrate them there despite their efforts to fly away. The wasps often show surprising persistence in building their paper nests in particular large, smooth-barked trees, such as ceibas, and specifically on the trunks and under the larger branches of jagüey trees in the Ciales-Mantí valley. A nest on such a frail support as molasses grass has been observed at Indiera. They often build on the concave sides of large rocks, or in roofless caves, and are an especial nuisance when determined to build under the eaves or porches of inhabited houses. Depending on the susceptibility of the



The Larger Paper-Nest Wasp, *Polistes major* Palisot de Beauvois, twice natural size. (Drawn by Fritz Maximilien.)

person and the part of the body attacked the sting of *Polistes americanus* varies from a temporary annoyance to a serious injury. Spraying with 5% DDT in kerosene will not kill the wasps in flight, or at least they succeed in flying away without apparent injury. But it does cause them to leave their nests, and they will not attempt to rebuild for several weeks, even in the most favored place if it has been drenched with DDT.

Dr. Wetmore found that the adults of *Polistes americanus* are eaten by the kingbird, petchary, flycatcher and wood pewee, and Dr. Danforth by the cliff swallow, and they have subsequently been found in the stomach remains of a judío shot at Florida. The wasp is not too active to escape capture by the crested lizard, nor by the Asilid fly, *Proctacanthus rufiventris* Macq., but a somewhat unexpected enemy is fungous disease. Wasps

stuck to the leaf of *Didymopanax morototoni* at Lares had been killed by a fungus identified by Miss Vera K. Charles as *Hirsutella saussurei* (Cke.) Speare. The fungus sticking another individual to a citrus leaf, collected by Mr. Felipe Mora at Lares, was identified by her as *Cordyceps sphecocephala* (Kl.) B. & C. According to Mr. Karl V. Krombein, "the local form of this wasp should be called **Polistes crinitus americanus** (F.)."

Polistes major Palisot de Beauvois, as determined by Miss Grace Sandhouse, is considerably larger than the endemic *Polistes americanus*, being seven-eighths of an inch long. Presumably it is a new arrival, for, according to Dr. J. C. Bequaert (Entomological News, **47** (1): 7–13. Philadelphia, January 1936), the first record from Puerto Rico was of collection by Mr. Francisco Seín in September 1930 at Lares. It is supposed that the hurricane of 1928 brought this larger and more powerful species to Puerto Rico, and also to Mona Island, as Dr. Luis F. Martorell found it there in abundance (August 8, 1939), nesting in a coconut palm, and on seagrape and beefwood. It now occurs in all parts of Puerto Rico, but is not especially abundant, altho frequenting the same flowers and having the same habits as the endemic species of attacking caterpillars. Specifically (Mayagüez Station Report for 1939, p. 26), it has been noted as killing the caterpillars of *Terastia meticulosalis* Guenée, the tip-borer of bucare trees, near Mayagüez, where "it was observed that a wasp secured and devoured a borer by holding it in its mandibles and feeding on the body fluids."

Mischocyttarus phthisicus (Fabricius), listed as a *Polybia* by Drs. Gundlach, Dewitz and Ashmead, is possibly found only in the western end of Puerto Rico, as all the recent records of collection are: intercepted in an orange grove at Barceloneta, and at Adjuntas, and, as determined by Dr. K. A. Bartlett, attacking the caterpillars of *Terastia meticulosalis* Guenée at Mayagüez. As *Megacanthopus indeterminabilis* (Saussure) it is listed by Mr. R. H. Van Zwaluwenburg as P. R. 66. *Polybia mexicanus* Saussure, listed by Mr. Ashmead from Puerto Rico is also a synonym.

Mischocyttarus cubensis (Saussure), not mentioned by Dr. Gundlach, but listed as a *Polybia* by Drs. Stahl and Ashmead, and later identified as a *Megacanthopus* by Mr. S. A. Rohwer, is only three-eighths of an inch long. The expanded apex of the pedicel of its abdomen is bright yellow, and indeed its markings of yellow and orange exceed in extent those of black. It builds an irregular, brownish, papery nest of ten cells of usable size, and a few others much smaller. For the most part, it lives at the higher elevations, collections having been made on El Duque near Naguabo, and in the higher coffee groves of Cialitos. Dead specimens found near Lares were stuck to citrus leaves by a fungus identified by Miss Vera K. Charles as *Cordyceps sphecocephala* (Kl.) B. & C. It is possibly this species which Dr. Stuart T. Danforth found in the stomach contents of a kingbird.

The wasp may occur near sea-level, having been intercepted in grapefruit groves at Bayamón and Vega Alta, and Prof. J. A. Ramos (1947–68) found a nest "under a leaf of a tree at Sardinera Beach" on Mona Island.

APOIDEA (Bees): Halictidae (Sweat Bees)

Agapostemon portoricensis, described by Prof. T. D. A. Cockerell (Proc. U. S. National Museum, **55** (2264): 209. Washington, D. C., 1919) as a variety of *radiatus,* from two males collected by Mr. Aug. Busck at Mayagüez, January 1899, is a bee 9 mm. long, with bright green head and thorax, light yellowish legs, the abdomen brown above except for the yellow margins of the first four segments. This is what Drs. Gundlach and Stahl doubtfully list as *Agapostemon festivus* Cresson ("the male of *A. poeyi* Lucas" which has a bluish-green abdomen), or *A. tricolor* Lepeletier; to which, because of obvious differences, Cresson had given the MS name of *A. krugii.* A cluster of twenty or thirty of these bees was noted on a few grapefruit leaves at Manatí, June 7, 1916, but subsequent collections have been of single individuals, one having been found in three square feet of sandy pasture at Pt. Cangrejos, and others often noted on sandy beaches, frequenting flowers in the more humid sections of the Island. Its distribution is not limited, however, to such areas, for it has been collected at Yauco and Ponce, as well as in the mountains at Jájome Alto, and between Cayey and Salinas, and at Maricao, Villalba and Luquillo. Dr. Luis F. Martorell found it, as identified by Miss Grace Sandhouse, common on the flowers of *Lantana camara* at Sardinero and Playa de Pájaros, Mona Island.

Augochlora busckii, described by Prof. T. D. A. Cockerell (Proc. U. S. National Museum, **37:** 493. Washington, D. C., 1910), the type from Aguadilla, has since been found in grapefruit groves at Bayamón and Dorado, and also at Jájome Alto. It is an iridescent greenish-blue bee with black antennae, legs and wing veination. Presumably this is the *Augochlora parva* Cresson of Cuba which Drs. Gundlach, Dewitz, Stahl and Ashmead list from Puerto Rico, and of which Dr. Wetmore reports finding remains in the stomach contents of a kingbird.

Much smaller than the above are the little shining greenish-black bees of the genus *Halictus,* the remains of which Dr. Wetmore reports finding in the stomach contents of the wood pewee. They occur on El Yunque, on the beach at Luquillo and Mameyes, and on Mona Island, but no species identification was made of those from Mona. Presumably, however, this is *Halictus* **busckiellus** described by Prof. T. D. A. Cockerell (Ann. Mag. Nat. History, **16:** 9. London 1915) from specimens collected in Santo Domingo. It is also present in Puerto Rico, for Miss Grace Sandhouse thus

identified some intercepted on the flowers of *Bidens pilosa* at Bayamón, and Mr. Karl V. Krombein as **Lasioglossum (Chloralictus) busckiellus** (Cockerell) a male from La Plata and a female from Lajas, besides many from flowers of coriander at the Isabela seed farm in April 1948, and from flowers of Queen Ann's lace at Río Piedras in June 1948.

Halictus proangularis Ellis, described (Entomological News, **25** (4): 155. Philadelphia, 1914) with the type from Bayamón, has since been intercepted on milkweed flowers from the type locality and on crotalaria flowers at Arecibo. The length of the female is 6.5 mm., "head, thorax and abdomen rather dark, uniform greenish blue, abdomen more shiny," "the sharp tubercles and anterolateral angles of the prothorax" and "the uniform greenish blue color of the dark wings" being distinctive. The *Halictus poeyi* Lepeletier listed by Ashmead is presumably one of these.

Panurgus parvus Cresson is listed from Puerto Rico by Drs. Gundlach, Dewitz and Ashmead, but has not since been collected.

Euceridae

Melissodes trifasciata, described from Mayagüez, Puerto Rico by Mr. E. T. Cresson (Proc. Acad. Nat. Sciences, Philadelphia, 1878, p. 208), is a short, plump, hairy, medium-sized black digger-bee, three segments of the abdomen being transversely banded with yellow. The males have extremely long antennae, and, as identified by Mr. Karl V. Krombein, have been most recently found in abundance on the flowers of coriander, *Coriandrum sativum*, at the Isabela seed farm, in March 1948. It occurs in all parts of the Island, earlier collections or interceptions having been made at Parguera and Guayanilla, as well as at Orocovis, Barceloneta, Bayamón, Palo Seco and Río Piedras, frequenting the flowers of roble, crotalaria, sweet potato and "anamú" (*Petiveria alliacea*). This bee is listed by Drs. Gundlach and Stahl, and in addition, *Melissodes mimica* Cresson, not since collected in Puerto Rico.

Anthophoridae

Exomalopsis globosa (F.), a small shining black bee, has been repeatedly identified from Puerto Rico: by Mr. J. C. Crawford, Mr. S. A. Rohwer, Miss Grace Sandhouse, and most recently by Mr. K. V. Krombein, from flowers of coriander at Isabela. First observed by Mr. G. B. Merrill tunnelling in hard clay at Guánica, these bees occur in all parts of the Island: Yauco, Jayuya, Mayagüez, Guajataca Dam, Arecibo, Barceloneta, Florida, Tortuguero Lagoon, Río Piedras, Mameyes, Cayey, and La Plata; frequenting many kinds of flowers including both kinds of "botoncillo," mango and crotolaria and *Barbiera pinnata*. As no other species of this genus

has recently been found here it may be presumed that the *Exomalopsis pulchella* Cresson noted by Dr. Gundlach as "común," and *Exomalopsis similis* Cresson, also listed by him and by Drs. Dewitz, Stahl and Ashmead, are misidentifications for this one common species of black bee.

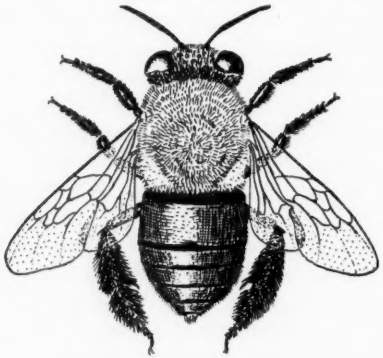
Anthophora krugii, described from Puerto Rican material by Mr. E. T. Cresson (Proc. Acad. Nat. Sciences, Philadelphia, 1878, p. 188), is a rather large plump black bee with the apical margin of all segments yellow, the fore part of the abdomen and the rear of the thorax coarsely pubescent with chestnut hairs, the face with silvery ones. Dr. Gundlach notes: "Mr. Cresson la consideró distinta de la *A. tricolor* F." and gives the MS name of *krugii*, while Dr. Stahl has the old name of *Magilla tricolor* for his specimens. Mr. Thos. H. Jones at Río Piedras observed a hundred or more of these bees "resting or flying about in weeds of 'artemisa cimarrona' (*Parthenium hysterophorus*) in bright sunlight at 1 PM, May 23, 1912, congregated in a small area," and caught forty of them with one sweep of the net. Mr. J. C. Crawford found that all were males. Females have been observed nesting in the clay banks of roadways: in Guajataca Gorge, and between Ciales and Villalba. On Mona Island Dr. Luis F. Martorell observed their burrows in the walls of the Viejo Lirio cave, Playa de Pájaros, in the spring of 1940, and also noted wasps frequenting the flowers of *Moringa oleifera* and *Colubrina ferruginosa*. At Río Piedras, they were noted frequenting tomato flowers by Dr. Richard T. Cotton, and on the edge of one of Aguirre's cane fields, Mr. D. L. Van Dine recorded their abundance on unspecified flowers. Despite their swift flight Dr. Wetmore found that they had been caught and eaten by the kingbird.

Hemisia lanipes (Fabricius), a medium-sized bee with chestnut abdomen and thorax densely covered with yellow pubescence, is normally not very common in Puerto Rico. Dr. Gundlach had specimens from Mayagüez, and Dr. Stahl records it as *Centris fulviventris* Cresson and *Centris dentipes* Smyth, not in synonymy. Individual wasps have since been taken at Río Piedras, Bayamón and Salinas. On Mona Island, Dr. Luis F. Martorell in August 1939 collected but a single specimen on Sardinera Beach, but on the same beach on March 31, 1940 he found them very abundant, frequenting the flowers of *Moringa oleifera* during the early sunny hours of the morning, and again late in the afternoon, but not at midday.

Hemisia haemorrhoidalis (Fabricius), a considerably plumper bee, densely pubescent with black hair on the head, thorax and fore part of the blue-black abdomen, has reddish hair on its apex. The male, as identified by Mr. Karl V. Krombein, has subtriangular dull yellow spots laterally on the second segment of the abdomen. Noted by Drs. Gundlach and Dewitz, and in Van Zwaluwenburg's list, it has since been found mostly

in the western end of the Island, at Peñuelas, Boquerón, Mayagüez, Aguada, Aguadilla, Lares and Barceloneta, with a single collection from Luquillo. Adults were abundant nesting in a clay bank at Guajataca, and in that region have been noted frequenting flowers of botoncillo and beans. In the spring of 1940 on Mona Island, Dr. Luis F. Martorell found them on flowers of *Moringa oleifera* and *Pisonia albida* on Sardinera beach and also on the plateau.

Hemisia versicolor (Fabricius), the largest of the Anthophorid bees occurring in Puerto Rico, black with thorax and hind tibiae densely pubescent with long, dull orange-yellow hair, is noted by Dr. Gundlach as "común," listed by Drs. Stahl, Dewitz and Ashmead, and (misidenified as *Centris decolorata* Lepeletier) in Van Zwaluwenburg's list. The males, with elongate



The largest Anthophorid Bee in Puerto Rico, *Hemisia versicolor* (Fabricius), three times natural size. (Drawn by Fritz Maximilien.)

dull yellowish triangular bands laterally on the second segment of the abdomen, have been seen in late summer on sandy beaches at Humacao, Dorado, Arecibo and Mayagüez, flying low over weeds, but obviously not interested in flowers. Now and then some alight momentarily on the sandy ground, and promptly take flight again. Among them are a very few females. On Mona Island, in August 1939, Dr. Luis F. Martorell found both sexes on the flowers of *Lantana camara* and in much greater numbers the following spring on the flowers of *Moringa oleifera, Colubrina ferruginosa* and *Pisona albida*. Dr. Wetmore found this bee to have been eaten by the kingbird.

Megachilidae: Leaf-cutting Bees

Coelioxys abdominalis Guérin-Méneville, a social parasite in the nests of other species of Megachilid bees, has a flattened triangular chestnut ab-

domen, black head and thorax, with dense bright yellow pubescence around the margins. It has most often been collected at Mayagüez (Gundlach, Van Zwaluwenburg and Danforth), but occurs in at least all the more humid parts of the Island, with records from Utuado, Guajataca, Bayamón and Río Piedras.

Megachile (Archimegachile) lanata (Fabricius), of which *Megachile vitrasi* Perez and *M. martindalei* Fox are synonyms according to Dr. T. B. Mitchell, is an African leaf-cutting bee which has been introduced into many islands of the West Indies. It is black with dark orange pubescence on the head, thorax and first two segments of the abdomen, becoming black on the apical three, which are sharply margined with white, and more obscurely, the two basal segments. It has been noted building nests of mud under the eaves of a house at Río Piedras, and also taking advantage of hollow bamboo stems to construct nests with a minimum amount of mud. The females visit flowers, having been observed frequenting those of bean at Río Piedras, of sweet-potato at Mayagüez and of crotalaria at Barceloneta, but without record of host intercepted in citrus groves at Trujillo Alto, Dorado and Barceloneta. More rarely, they have been noted frequenting the flowers of "botoncillo" (*Borreria verticillata*), at Yabucoa and along the north coast to Isabela.

Megachile insularis Cresson, as determined by Mr. Karl V. Krombein, and previously listed by Ashmead, is a considerably smaller species, lacking the dark orange pubescence, of which specimens have been collected by Dr. Stuart T. Danforth at Río Piedras and San Germán.

Megachile (Eutricharaea) concinna Smith, as determined by Miss Grace Sandhouse is a similar small bee, collected on flowers at Salinas, and by Prof. J. A. Ramos at Mayagüez, Santurce and Río Piedras.

Dr. T. B. Mitchell identifies the large but similar leaf-cutting bee from Mona Island and the more xerophytic areas of southwestern Puerto Rico as being an undescribed species of **Megachile**. Mr. E. G. Smyth made the first collection on Mona Island in 1913, but twenty-six years later Dr. Luis F. Martorell noted the terrible noise these bees made in the Viejo Lirio cave at Playa de Pájaros, looking for holes in the walls of the cave. The following spring he noted their abundance on the flowers of *Moringa oleifera* and *Pisonia albida*. Prof. J. A. Ramos collected them on the flowers of wild indigo at Faro de Cabo Rojo, and they have been intercepted at Guánica and Parguera. They are mostly black in color, with marginal yellow pubescence, each segment of the subtriangular abdomen being sharply margined with yellow.

Megachile poeyi Guérin-Méneville and *Megachile singularis* Cresson are the Cuban species of leaf-cutting bees listed from Puerto Rico by Drs.

Gundlach, Stahl, Dewitz and Ashmead, but, judging by the absence of more recent records, actually not present here.

Nomadidae: Cuckoo Bees

Nomada krugii, the endemic cuckoo bee which Mr. E. T. Cresson (Trans. Amer. Ent. Soc., **7:** 75. Philadelphia, 1878) described from the Puerto Rican specimens supplied by Dr. Gundlach, was listed as *Nomada cubensis* Cresson by Drs. Gundlach, Dewitz and Ashmead. It has not since been found.

Hypochrotaenia pilipes, originally described as a *Pasites* from Cuban specimens by Mr. E. T. Cresson (1865–183) as "chestnut-brown, polished; sides of face, clypeus, collar, tubercles, two spots on pleura, postscutellum and narrow costo-apical margin fuscous," is listed from Puerto Rico by Drs. Gundlach, Dewitz and Ashmead. Interceptions have been made on flowers of *Barbiera pinnata* at Barceloneta, of mango at Mayagüez, on pepper at Guaynabo, and at Loíza and Ponce, and most recent collection made on flowers of coriander at Isabela.

Melectidae

Melecta (Nesomelecta) pantalon, originally described as a *Crocisa* by Dr. H. Dewitz (1881–198) from the type collected in Puerto Rico by Dr. Gundlach, is the identification by Mr. Karl V. Krombein of a bee found by Mr. Francisco Seín at Lares, attached by its jaws to a dry twig, its body horizontal with the ventral side up. It is a blue-black bee, 13.0 mm. long, with dense silvery pubescence on head and thorax, very dense tufts of white hair on the sides of the anterior segments of the abdomen, and chestnut-colored legs.

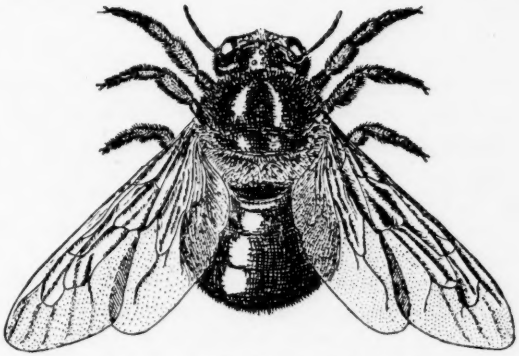
Mesonychium sp. is the identification by Mr. Karl V. Krombein of a slender black bee, 9.0 mm. long, with silvery pubescence, very short on the abdomen, and almost invisible in some lights, forming broad bands dorsally on the first three segments except along the median line. Mr. Francisco Seín collected one of these bees at Lares resting on grass, and unlabeled specimens are in the College collection at Mayagüez.

Melissa rufipes Perty is a name listed by Dr. Stahl.

Xylocopidae: Carpenter Bees

Xylocopa brasilianorum (Linnaeus), the only species of carpenter bee in Puerto Rico, was listed earlier as *X. morio* (Fabr.), of which Dr. Gundlach wrote: "Es notable por la diferencia de colorido entre el macho y la hembra (males are yellow, females black). Las larvas viven dentro de la madera en divisiones separadas en un tubo común, una encima de otra." These enormous bees, not as large as *Campsomeris atrata* but so broad as

to make them the largest Hymenopteron in Puerto Rico, occur in all parts of the Island, and possibly because more dead branches, undisturbed by man, are available for their tunnels on Mona Island, are especially abundant there. The males are comparatively rare. One came out of this tunnel in a dead branch of hibiscus not more than twice the diameter of the tunnel itself, very angry at being disturbed, September 1942 at Rio Piedras. The entrance was in the middle of the tunnel, which was about nine inches long, in many places lined, or dusty, with pollen. From a larger tunnel in a dead branch of mahogany tree, June 1940 at Hda. Algarrobo, Guayama, Dr. Luis F. Martorell saw eight adults emerge, and found that it contained two larvae and two adults. Prof. J. A. Ramos saw several males and several females emerge from a nest in an old branch of *Ficus stahlii* on Mona Island.



The Carpenter Bee, *Xylocopa brasilianorum* (L.), female. Twice natural size (Drawn by F. Maximilien.)

The bees are not fussy about the kind of wood in which their burrows are made, and records of fence-posts attacked, of several kinds of wood, are possibly most numerous. Old, deserted tunnels may serve as shelter for small lizards: a natural but somewhat unexpected case of a large insect making a shelter large enough for occupancy by a vertebrate animal. The female bees frequent many kinds of flowers, especially hibiscus, scaring away any butterfly or other bee or wasp that might be sucking nectar there first.

Apidae: Honey Bees

Apis mellifera Linnaeus, the domestic honey bee, had long been present in Puerto Rico at the time that Dr. Gundlach wrote: "Esta especie (*Apis mellifica* L.) fué introducida de Europa y existe ahora, no solamente en los colmenares, sino también cimarrona en árboles huecos de los montes

y en las grietas de las peñas." Mr. Aug. Busck, who visited the Island in 1899, noted that "very large colonites of a dark variety of *Apis mellifica* were abundant in hollow trees and especially in caves, sometimes also in outhouses. These are annually smoked out and furnish large quantities of honey." Mr. W. V. Tower was much interested in commercial "Bee Keeping in Porto Rico" (Circ. No. 13, P. R. Agr. Expt. Station, pp. 1–13, fig. 1. Mayagüez, 1913), and Dr. E. F. Phillips visited the Island to report on "Porto Rican Bee Keeping (Bull. No. 15, P. R. Agr. Expt. Station, pp. 1–24, pl. 2. Washington, D. C., May 29, 1914). Practical work on "Some Needs of the Porto Rican Beekeeper" by Mr. Rafael Vidal (Gleanings in Beeculture, **44:** 409–10, fig. 1. Medina, Ohio, 1916) eventually led to experiments in "Rearing Queen Bees in Porto Rico" by R. H. Van Zwaluwenburg & Rafael Vidal (Circ. No. 16, P. R. Agr. Expt. Station, pp. 1–12, fig. 5. Washington, D. C., February 26, 1918).

The practical beekeeper, Mr. P. G. Snyder, reported his experiences of "Beekeeping in Foreign Lands" (Gleanings in Beeculture, **48:** 721–24, fig. 3. Medina, Ohio, 1920), and most recently Mr. David A. Rodríguez has discussed "Problemas Apicolas de Puerto Rico" (Circ. No. 99, Est. Expt. Insular, Río Piedras, pp. 1–22, fig. 4. San Juan, 1932). Of the early history of beekeeping, Mr. Edmundo Colón has written in his book on "Datos sobre la Historia de la Agricultura de Puerto Rico antes de 1898," (pp. viii & 302. Cantero, Fernandez y Cía., San Juan, 1930).

On the natural enemies of domestic honey bees, Dr. Alex. Wetmore noted their being eaten by the local endemic kingbird in Puerto Rico, just as they are eaten by its counterpart in continental United States. More recent examination of the stomachs of the "pitirre," shot near Laguna San José, Sabana Llana in January 1935, showed that a maximum of 15 and a minimum of 3 individual honey bees formed from 100% to 30% of the stomach contents of these birds, five of them having eaten nothing else. Mr. H. Bourne, the Barbadian cane technologist employed by Guánica Centrale, told of how the specimens of *Bufo marinus* sent to Mr. D. W. May, Director of the Mayagüez Station, were collected in Barbados, from around a hive of bees. Naturally, their descendents in Puerto Rico might also be expected to eat bees, given the opportunity, unless the hives were placed well off the ground and had a shelf in front of the entrance, where the laden bees could rest on their return. In extreme cases hives may have to be fenced in with tight chicken-wire to keep the toads away. The little yellow grass lizard, *Anolis pulchellus*, also eats bees. Despite all these natural enemies, however, the number of honey bees observed on any aggregation of flowers is the yardstick by which one judges the comparative abundance of other flower-frequenting insects. It proved especially useful when determining the abundance of the introduced changa parasite, *Larra*

americana, on botoncillo flowers. Dr. Phillips had noted the importance of these flowers in the secretion of nectar for the domestic honey bees, and intensive observations on the flowers of *Hyptis atrorubens* and *Borreria verticillata* show how much these unobtrusive plants furnish.

Surprisingly enough, the investigations of Mr. Francisco Seín on "Las Abejas en los Cafetales" (Circ. No. 79, Est. Expt. Insular, Río Piedras, pp. 1-6, fig. 1. San Juan, November 1923) indicated that insects are not necessary for the setting of the coffee crop, the flowers being self-fertile or wind-pollinated even when thrips and ants are excluded from them. Some coffee growers had seen honey bees knock the petals off the withering coffee flowers, and claimed that they were knocking off the young berries before they had set: a hasty observation, not supported by the facts as to the injury that honey bees might cause. But Mr. Seín's experience showed that, except for the beekeeper, no benefits were obtained by an abundance of either domestic or wild bees in groves. Indeed, unless the bees also belonged to him, the presence of the domestic bees was neutral so far as the coffee grower was concerned.

ACKNOWLEDGMENTS

The very close friendship, both personal as well as official, between Dr. L. O. Howard, Chief of the Bureau of Entomology, USDA, Washington, D. C., and Mr. D. L. Van Dine, Entomologist (1910–1914) of the Sugar Producers' Experiment Station at Río Piedras, resulted in all the facilities of the Bureau and of the U. S. National Museum being made available by Dr. Howard for the prompt identification of whatever insects might be collected in Puerto Rico. The transfer of the Station to the control of the Insular Government (coming under the direction of the Department of Agriculture and Labor, or the Department of Agriculture and Commerce, and later of the University of Puerto Rico), and the departure of Mr. Van Dine did not break the continuity of this co-operation, to the inestimable benefit of his successors. Indeed, changes in organization at Washington have only sometimes resulted in direct communication with the specialist making the determinations, or, more often, with Dr. Harold Morrison, and later Mr. C. F. W. Muesebeck, in Charge of Insect Identification at the National Museum. This has been of the greatest value to the entomologists at Río Piedras, and it is upon the cumulative identifications thus obtained that the nomenclatorial frame for the present publication and previous annotated lists has been built. To all the specialists, from the earliest years to the present, at Washington, and also at New York, Cambridge, London, and sometimes elsewhere, and most especially to Mr. Muesebeck who had prepared a photostatic copy of Moritz' paper and has been unwearying in answering questions and clearing up disputed points, the writer is most sincerely grateful. To them should go the credit, the errors and the mistakes are mine.

Mr. Curtis W. Sabrosky, Dr. Alan Stone and Dr. Willis W. Wirth, examining the section in the Diptera in which they were particularly interested when it had already entered the stage of page proof; Messrs. J. G. Franclemont, J. F. Gates Clarke and Hahn W. Capps for the Lepidoptera; and Mr. C. F. W. Muesebeck, Mr. A. B. Gahan, Dr. M. R. Smith and Mr. K. v. Krombein for the Hymenoptera, may not be especially happy (nor is the writer) at the necessity of fitting their last minute suggested changes into the available space. Those considered essential now by Dr. T. E. Snyder for the Isoptera, Dr. A. B. Gurney for the Orthoptera, and Dr. E. A. Chapin in the Coleoptera, who examined sections in the original MS several years ago, and by Dr. J. D. Hood in the Thysanoptera, can only be given here as addenda.

The accumulation of biological data to hang on the nomenclatorial frame was largely automatic after having been initiated by Mr. Van Dine

in the accession catalog of the Station. To his wisdom in starting such a system and to the unfailing and most obviously meticulous care with which it was expanded by Mr. Thos. H. Jones, few subsequent workers have failed to respond by adding their quota. Previous annotated lists have given the data as recorded, and it is hoped that no significant contribution has failed of due credit in the present publication.

Dr. Robert Morss Lovett, of the English Department of the University of Chicago, giving a course in "Creative Writing" at the University of Puerto Rico, read all the MS or page proof, ironing out roughnesses and obscurities, and suggesting the omission of numerous commas, some of which the writer still thinks should have remained. Dr. Lovett should not, however, be held responsible for any infelicity in the English of the final publication, for numerous changes were made after his departure, and the writer can only record gratitude for his improvement of the parts of the original MS that actually passed under his inspection.

During a summer vacation from Swarthmore, my son, Oliver Wolcott, prepared a subject index from galley proof that proved of inestimable value in the insertion of the page references when final page proof was available.

To the numerous young ladies (their specific identity often already lost in the constantly changing stenographic personnél of the Station) who copied larger or smaller sections of the MS, the writer is most grateful for the drudgery from which he was saved. Whether it was a real saving in time may be questioned, for each girl had a different system of making errors. Too late to be used for most of the original MS, Mrs. Lucy Fránqui de Santiago, now appointed for the exclusive use of the Division of Entomology, is a pearl without price, for she copies exactly, including, alas, all the errors of the writer which her inexperience in scientific writing has not detected in the MS and called to his attention.

The Editor of the Station publications, Mr. E. Molinary Salés, is to be thanked for reading the final proof, checking especially the local personnél and locality records, and words, phrases and quotations in Spanish.

ADDENDA et CORRIGENDA

On the title page of No. 1, read ISOPTERA instead of ISPOTERA.

On page 30: The red spider first noted by Mr. Ferdinand Méndez injuring the appearance of the underside of the leaves of orchids has been determined by Dr. Edward W. Baker to be his *Tenuipalpus pacificus*, of the family Phytoptipalpidae (= Pseudoleptidae): "a serious pest to orchids in California."

On page 45, add to the second paragraph: Dr. John W. H. Rehn has recently shown that Puerto Rico has two distinctive species of "The Genus **Aspiduchus**" (Noctulae Naturae 231, pp. 7, pl. 1. Philadelphia, Feb. 14, 1951), describing that collected by Mr. Crampton in the caves at Corozal as **borinquen,** and that collected by Prof. J. A. Ramos and Mr. J. Maldonado Capriles in caves at Cabo Rojo as **cavernicola.**

"The drawing on page 49," as is noted by Dr. A. B. Gurney in a letter of March 19, 1951, and as he showed the writer in Washington a few days later, comparing drawings in literature, "may be the species indicated, as I wrote you in 1947 was probably the case. A further comparison with the illustrations of Westwood and Saussure leaves some doubt that either *ceratocephalum*, or the supposedly synonymous *adumbratus*, is involved," and indeed it "resembles fairly well some species of *Antillophilus*." The description by Rehn & Hebard of **Antillophius restrictus** Redtenbacher checks closely with the more obvious characters shown in the drawing and in other specimens from El Yunque, and presumably is the correct name.

The small, winged, green or brown walkingsticks found by Dr. Luis F. Martorell, September 26, 1950, feeding on the leaves of "jácana," *Lucuma multiflora* A. DC., at El Collao, the highest point in the pass between Cayey and Salinas, tentatively identified by Dr. Gurney as *Aplopus jamaicensis* (Drury), actually differ in details from the illustration of this species, and can only be recorded as of the genus **Aplopus.**

On page 58, after fourth paragraph, add:

Cycloptilum antillarum Redtenbach, noted by Dr. Gundlach as *Liphoplus krugii* Saussure, "de los contornos de Mayagüez," has not since been taken there, altho "numerous specimens were swept from vegetation on Sardinero and Uvero Beaches" on Mona Island by Prof. J. A. Ramos (1947-10), and it has been intercepted in a maga tree at Arecibo, and at San Juan.

Dr. Thomas E. Snyder's "Catalog of the Termites (Isoptera) of the World" (Smithsonian Misc. Collections, Vol. **112,** pp. 490, Washington, D. C., November 1, 1949), published at the same time as No. 1 of "The Insects of Puerto Rico," requires certain changes in the nomenclature of the termites discussed in the latter. As noted by Dr. Snyder in his letter of January 10, 1951, these are:

"p. 62: Emerson and I for the present are placing **mona** in the genus **Kalotermes;** there are *Neotermes* characters, however, the genera need further study and revision; there are overlapping characters in these former subgenera.

"p. 63: **cavifrons** is a **Cryptotermes."**

the legend under the illustration on p. 64 should read *Kalotermes,* not *Kalotenmes.*

"p. 68: **corniceps** is now placed in the genus **Procryptotermes.**

"p. 69: *Eutermes theobromae* is an African species from St. Thomas; it is a valid species, not a synonym of **arboreus.**

"p. 73: *Nasutitermes creolina* soldiers from Puerto Rico are **Nasutitermes nigriceps** (Haldeman); the winged from Montserrat *ephratae."*

Dr. J. D. Hood notes (page 94) that *Gynaikothrips uzei* Zimmerman is not a synonym for **Gynaikothrips ficorum** Marchal, all records of infestation on *Ficus nitida* referring to the latter species. The former is presumably restricted to *Ficus benjamina* as host, not observed infested in Puerto Rico.

Dr. Hood states that *Diceratothrips wolcotti* Morgan (page 95) is a synonym of **Diceratothrips picticornis** Hood, and doubts the occurrence of his *Ommatiothrips gossypii* in Puerto Rico. **Aleurodothrips fasciapennis** Franklin was not originally described in that genus, nor **Hoplandothrips reynei** Priesner, nor **Franklinothrips vespiformis** Crawford.

Dr. Dozier's record of *Liophloeothrips portoricensis* Watson MS may possibly refer to a **Karynothrips,** to which genus *Haplothrips* **merrilli** Watson is now assigned.

Mr. H. J. Franklin originally described **Haplothrips gowdeyi** (page 96) as *Anthothrips.* Dr. Hood's *Haplothrips* **tibialis** is now assigned to the genus **Adraenothrips.** "**Chaetanaphothrips orchidii** (Moulton) is not an *Anaphothrips."*

On the first line of page 97, read **melaleucus** for **melalencus,** and on the fifth line, **Limothrips** for **Limnothrips,** this not being the genus in which Mr. A. H. Haliday originally described the species **cerealium.** On page 98, *Thrips abdominalis* is now **Microcephalothrips abdominalis** (Crawford). **Thrips tabaci** (page 99) was originally described by Mr. K. Lindeman, not Lindemann. The presently accepted name for the continental bean thrips, (second paragraph, page 101) is **Caliothrips fasciatus** (Pergande).

On page 106, after fifth paragraph, add:

The publication by Drs. John S. Caldwell and Luis F. Martorell of their paper on "Cicadellidae" (Jour. Agr. Univ. P. R., **34** (1—January 1950): *in press*) renders the following account, written before the trip of Dr. Caldwell to Puerto Rico to collect leafhoppers was even contemplated, and in galley proof while collections were still being made, largely obsolete. Before their publication has appeared, however, Mr. Julio Bird has collected nymphs and adults of an **Empoasca** on pumpkin at Corozal, which will feed on papaya, considered by Dr. David A. Young, Jr., of the U. S. National Museum, to be a new species.

On page 134, second paragraph, read **Megamelanus** for **Megamelus.**

On page 141, after sixth paragraph, add:

Neomalaxa flava, described by Mr. F. Muir (1918-426) from Mayagüez, P. R., and listed by Muir & Giffard (1924-9) and Dr. Osborn (1929-110 and 1935-239), is quite common generally on low vegetation in the mountains and at the edge of coffee groves on "cohitre," *Commelina elegans.* The nymphs produce five long filaments from the caudum, besides many smaller ones, and fine threads of wax from the thorax.

on page 157, the tenth line should read:

phyllum argenteum), coconut and other trees, as noted by Mr. Thos. H. Jones in "A List of the Coccidae of Puerto Rico" (Jour. Board of Commissioners of Agr. P. R., 1 (1): 1–16, ref. 5, San Juan, 1937).

on page 162, line 34, read "Dusting with," not "Dustin w gith."

on page 187, completing the fourth paragraph:

Miss Louise M. Russell has identified as **Bemisia tabaci** (Genn.) whiteflies collected by Mr. Julio Bird which he had used in the transmission of a mosaic disease of "tuatúa", *Adenoropium gossypifolium.* She identifies as **Bemisia inconspicua** (Q.), or of the *tabaci* complex, those on other common euphorbiaceus plants, as on "lechecillo", *Euphorbia* (now *Chaemesyce*) *hypericifolia* sent to Dr. Quaintance in 1915.

on page 193, the second paragraph should read:

The chrome yellow, conspicuously marked with black **Runibia perspicua** (F.) has been found on Vieques Island, according to the determination by Mr. Barber of a specimen in the AMC (Mayagüez College) collection, dated xii-35. Mr. Barber (1939-295) describes a specimen from Bolivia as being red, but no such specimen is now in the U. S. National Museum, and all there are chrome yellow in color, as is also one recently collected by Miss Ann Wolcott on El Yunque, November 11, 1950, both adults and

nymphs on *Brunfelsia lutea* Krug & Urban, an endemic solanaceous plant, locally called "vega blanca."

On page 200, line 10 from bottom, read **Exogenus** for **Xenogenus.**

on page 211, after third paragraph, add:

Pygolampis pectoralis (Say), as determined by Mr. Mario Pérez, confirmed by Mr. Reece I. Sailer, was taken in a light-trap at Cidra in December 1950. This has not previously been recorded from Puerto Rico, altho earlier collections have been made: light-trap at Gurabo (Maldonado) and at Jayuya (J. A. Ramos), in 1943 and 1945.

on page 213, after first paragraph, add: **Mesoveliidae.**

Mesovelia mulsanti caraiba Jaczewski, described from others of the West Indies, Mexico and Panama, was first recorded from Puerto Rico by Dr. Alex. Wetmore (1916-41) as having been eaten by the spotted sandpiper. Mr. Barber records collection at seven localities in all parts of the Island. Dr. Hoffman found it in "charcas" at Isabela, and it has been intercepted at San Juan.

on page 216, after first paragraph, add: **Dolichomiris linearis** Reuter, as determined by Mr. Barber, has been swept from grass at Villalba.

On page 219, after line 12, add: **Engytatus geniculatus** Reuter, in grapefruit grove at Añasco.

page 223, line 6: the correct specific name for the introduced bullfrog is *catesbeiana.*

page 224: The Actual Date of Publication (Distribution in Puerto Rico) is November 7, 1950.

Dr. E. A. Chapin notes the following errata:
On Cover of No. 2, **Mordellidae** instead of **Mordelidae.**

on page 225, after first paragraph, add: **Rhysodidae.**

Mr. W. S. Fisher has identified as species of **Clinidium** beetles intercepted by Mr. R. G. Oakley on decaying wood at Adjuntas, and collected by Dr. Donald De Leon on dead "nuez moscada" tree at Guavate Camp, Cayey.

on page 227, after first paragraph, read **Carabidae,** not **Carbidae.**

on page 228, line 9, **Ardistomis** is correct. Dr. Chapin writes that "the spelling *Ardistomus* was used apparently without authority in the Junk catalogue and that is where Blackwelder picked up the name."

on page 229, in seventh paragraph, add: **Perigona nigriceps** Dejean also occurs in Puerto Rico (Blackwelder 1944-44), this being possibly what is listed by Dr. Gundlach as *Trechius* (not *Trechus* Vlairville, *in* Blackwelder 1944-32) *substriatus* Chevrolat "acaso nombre inedito; existe tambien en Cuba."

on page 230, last line, Dejean is correct, not DeJean.

on page 231, line 6, *Rhombodera* is correct, not *Rhomobodera.*

on page 233, line 7 from bottom, read *cumscripta*, not *cunscripta.*

on page 235, between **Catopidae** and **Limnebidae,** add: **Leiodidae.**

Mr. R. G. Oakley intercepted on pods of *Inga vera* at Juana Diaz some beetles identified by Mr. W. S. Fisher as being a species of **Aglyptinus.**

on page 235, line 9 from bottom, read **testaceus,** not **testaceous.**

on page 246, line 9, **Passalidae** is correct, not **Lucanidae, Stag Beetles.**

on page 246, line 5 from bottom, read *Pinotus*, not *Copris.*

on page 264, "the change of name from **Ligyrus tumulosus** to **Ligyrus cuniculus** was made by Arrow in the Junk catalogue, Part 156, p. 37, 1937."

Insert on page 269, after **Byrrhidae.**

Chelonaridae

Chelonarium punctatum Fabricius, originally described from Cuba, where Dr. Gundlach states "no es rara," is a most unique dark, little, oval beetle, flecked above with bluish-white, which has its head on the ventral surface of the prothorax. "Playing 'possum," with its legs closely appressed to the body, it looks more like a seed than a beetle. Collected by both Drs. Stahl and Gundlach, the family was omitted by Dr. Blackwelder from its proper place in his list, and appears as "ADDENDA," pp. 923–925, with the Puerto Rican species listed on page 924. The beetle occurs in all parts of the Island, adults having been noted under such a variety of conditions, resting on host, as to indicate none of significance but the discovery of a pair in coitu, October 2, 1923, at Río Piedras, in recently cut banana corm, placed on the ground in a banana plantation for the collection of adults of the corm weevil, *Cosmopolites sordida* Germar. Mr. Francisco Seín found two pupae inside shed larval skins in a rotten tree stump at Lares, June 14, 1921, from one of which an adult emerged that was identified by Dr. E. A. Schwarz, all of this material now being in the National Museum. Elytra have been noted in bird dung at Camuy,

and in an excrement pellet of *Bufo marinus* at Río Piedras, thus apparently the beetles are sufficiently common to be a minor item in the food of both birds and toads.

on page 270, line 7, read *navicularis*, not *nauicularis*.

on page 277, line 3 from bottom, read *impressa*, not *impresa*.

on page 280, line 13, read **Taphrocerus,** not **Taphocerus.**

on page 197, line 1, read *Epuraea*, not *Epurma*.

on page 301, line 3 from bottom, read *varivestis*, not *varvestis*.

on page 309, line 14 from bottom, read aberration, not aberation.

on page 312, line 11 from bottom, read **Coelophora,** not **Coleophora.**

on page 313, line 1, read *Coelophora*, not *Coleophora*.

on page 326, line 2, read **Trientoma,** not **Treintoma.**

on page 328, line 13, read A. J. Mutchler, not, J. A. Mutchler.

on page 369, the paragraph beginning **Podagrica cyanipennis** Weise, should continue:

As a *Cyrsylus*, Mrs. Doris H. Blake (Jour. Washington Academy of Sciences, **39** (11): 367–371, pl. 1, Washington, D. C., November 18, 1949), records collection by Mr. August Busck, at Fajardo in February 1899.

on page 375, last line, read **rufimanus** for **rufinanus.**

on page 377, line 7 from bottom, read **Homoeocloeus,** not **Homocloeus.**

on page 381, line 20, read Montserrat, not Monteserrat.

on page 403, line 8 from bottom, add: and of *Erodiscus* eaten by the killdeer.

on page 415, line 4 from bottom, add: and those intercepted by him on rotten wood in the mountains back of Yauco as a species *Ulosomus* and of **Dryophthorus.**

on page 416: Actual Date of Publication (distribution in Puerto Rico): February 5, 1951.

on page 431, end of third paragraph, add:

The results of this abruptly terminated investigation are reported as "Field Studies on the Bionomics of *Anopheles albimanus*, Part 1: Aestiva-

tion of Immature Stages—Progress Report" (Jour. National Malaria Society, **9**(2): 176–180, fig. 2., June 1950) and "Parts II and III: Diurnal Resting Places—Progress Report" (*idem.* **9**(3): 268–279, September 1950).

on page 473, 7th paragraph, add: Mr. C. W. Sabrosky identified as **armigera** (Townsend) flies reared from larvae of *Melipotis fasciolaris* (Hübner), the lingnum-vitae looper caterpillar, very abundant north of Salinas in March 1951.

on page 510, end of first paragraph, add:

In numerous fruits of the date palm, *Phoenix dactylifera* L., at Aguada, November 4, 1950, Mr. C. E. Stringer, Jr., intercepted maggots which when reared to adult were identified by Dr. Alan Stone as being *Anastrepha mombinpraeoptans.*

on page 510: in eighth line from bottom, add:

From fruits of the "almendrón", *Prunus occidentalis* Swartz, at Jayuya on June 12, 1951, flies were reared which proved to *Anastrepha suspensa.*

on page 511, after first paragraph, add:

Polymorphomyia basilica Snow, as identified by Dr. Aldrich from material reared by Dr. Richard T. Cotton from elongate oval gall in stem of "Santa María," *Eupatorium odoratum*, at Río Piedras, has also been recorded by Dr. Curran at Naguabo and Aibonito, and intercepted at Adjuntas.

on page 579, line 7 from bottom, read **Depiopeia,** not **Deiopeia.**

on page 600, line 2 from bottom, read *Encalypta*, not *Eucalypta.*

on page 633, after third line, add:

A perfect unrubbed adult of **Hemeroplanes parce** Fabricius, the silver-spotted sphinx, not previously reported from Puerto Rico, was found by Mr. Gaspar Rivera under a bougainvillea bush at Río Piedras, June 27, 1951.

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